m/023/0016
TASK 2996
cc: wayne
Tom
Lynn

0003

EarthFax

EarthFax
Engineering, Inc.
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May 22, 2009

Wayne Western
Department of Natural Resources
Division of Oil, Gas and Mining
1594 West North Temple, suite 1210
Salt Lake City, UT 84116

Subject: Chicken Creek Mine Notice of Intent
Sunroc Corporation

Dear Wayne:

As we have discussed, Sunroc Corporation is proposing to expand mining activities within the East Pit at Chicken Creek Mine and future intent to begin mining activities within the Upper West Pit at the same mine. To accommodate this increased mining activity at the Chicken Creek Mine, we have prepared this Notice of Intent as indicated on the enclosed pages.

Please review the Notice of Intent and contact Rod Dolph of Sunroc Corporation or myself with comments.

Please contact me if you have any questions.

Sincerely,

Rick

Richard B. White, P.E.
President

Enclosure

cc: Rod Dolph (Sunroc), Tom Lloyd (U.S. Forest Service)

RECEIVED
MAY 26 2009
DIV. OF OIL, GAS & MINING

M/023/0016
Task 2996
cc: Wayne
Tom
Lynn

Notice of Intention to Commence Large Mining Operations at the Chicken Creek Mine

Sunroc Corporation
Chicken Creek Mine
Levan, Utah

May 2009

EarthFax

EarthFax Engineering, Inc.
Engineers / Scientists
7324 South Union Park Avenue, Suite 100
Midvale, Utah 84047
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TO CONTINUE LARGE MINING OPERATIONS
AT THE
CHICKEN CREEK MINE

R647-4-101. FILING REQUIREMENTS AND REVIEW PROCEDURES.

The Chicken Creek Mine is located 1.5 miles east of the City of Levan within Chicken Creek Canyon. The Chicken Creek Mine has two sites; the west mine is located ½ mile up Chicken Creek Canyon on the south face of the canyon, the east mine is located 1.5 miles up Chicken Creek Canyon on the north face of the canyon. The gypsum mined at both sites exists in layers that are several hundred feet deep and has very little impurities.

Sunroc Corporation (Sunroc) is proposing to commence mining operations at the East and Upper West Pits and continue mining operations at the Lower West Pit of the Chicken Creek mine in Levan, Utah. In preparation for beginning operations at the Upper West and East Pit and continued operations at the Lower West Pit, this document has been prepared to accompany a Notice of Intention (NOI) to Commence Large Mining Operations (FORM MR-LMO), which is being submitted to the Utah Division of Oil, Gas, and Mining (the Division).

R647-4-102. DURATION OF THE NOTICE OF INTENTION.

The approved notice of intention (NOI), including any subsequently approved amendments or revisions, will remain in effect for the life of the mine. Sunroc understands that the Division may review the permit and require updated information and modifications when warranted. Additionally, Sunroc understands that failure by the operator to pay permit fees required by R647-4-101(5) or maintain and update reclamation surety as required may, after notice and opportunity for Board hearing, result in a withdrawal of the approved notice of intention.

R647-4-103. NOTICE OF INTENTION TO COMMENCE LARGE MINING OPERATIONS.

This NOI addresses the requirements of the following rules:

RULE #	SUBJECT
R647-4-104	Operator(s), Surface and Mineral Owner(s)
R647-4-105	Maps, Drawings and Photographs
R647-4-106	Operation Plan
R647-4-108	Hole Plugging Requirements
R647-4-109	Impact Assessment
R647-4-110	Reclamation Plan
R647-4-112	Variance
R647-4-113	Surety
R647-4-114	Failure to Reclaim
R647-4-115	Confidential Information
R647-4-116	Public Notice and Appeals
R647-4-117	Notification of Suspension or Termination of Operations
R647-4-118	Revisions
R647-4-119	Amendments
R647-4-120	Transfer of Notice of Intention
R647-4-121	Reports

R647-4-104. OPERATOR(S), SURFACE AND MINERAL OWNER(S).

104.1. OPERATORS

Sunroc Corporation is the operator of the Chicken Creek Mine in Levan, Utah. The permanent mailing address for the mine is P.O. Box 488, 525 West Arrowhead Trail, Spanish Fork, Utah 84660. The telephone numbers are voice (801) 722-2100 and Fax (801) 722-2130. The mine contact is Earl Davis.

104.2. SURFACE AND MINERAL OWNERSHIP

The proposed Chicken Creek Mine operation is located in Juab County, Utah, east of the City of Levan, Utah. The West Site is located on a ridge immediately south of Chicken Creek, approximately ½ mile up Chicken Creek Canyon, in Sec. 3, T15S, R1E SLBM and Sec. 33, T14S, R1E SLBM. The East Site is located on a ridge immediately north of Chicken Creek, approximately 1.5 miles up Chicken Creek Canyon, in Sec. 34, T14S, R1E SLBM and Sec. 33, T14S, R1E SLBM. The lands that would be affected by the mining operation are owned by Boyd Tom Aagard, Levan Land Company, Pyramid Gypsum Corporation, and the U.S. Forest Service. No state lands will be disturbed by the existing or proposed operations.

104.3. FEDERAL AND STATE CLAIMS, LEASES, AND PERMIT NUMBERS

The operations of the Chicken Creek Mine West Site are located on placer mining claims owned by Juab Gypsum, L.L.C. The operation of the Chicken Creek Mine East Site is located on placer mining claims owned by Sunroc. The U.S. Forest Service, Boyd Tom Aagard, and Levan Land Company are the surface owners of the West Site. The Levan Gypsum Company, the Pyramid Gypsum Company, and the U.S. Forest Service are the surface owners of the East site.

The rights to the minerals mined are owned by Sunroc. The rights to enter and conduct mining operations are based on placer claims as noted in Appendix 104-1. The U.S. Forest

Service and Utah Department of Oil, Gas, and Mining retain the right to enter the mine site at any time. Figures 104-1A and 104-1B, present the locations of private property, mining claims, and access easements.

The permit number for the mines from the Utah Division of Gas and Mining is M 023 016. The Division of Air Quality has issued A.O. No. DAQE-AN3072001-05 and Temporary No. DOQC-927-08 for operation of the mines see Appendix 104-1.

R647-4-105. MAPS, DRAWINGS AND PHOTOGRAPHS.

105.1. BASE MAP

The proposed Chicken Creek Mine operation is located in Juab County, Utah, east of the City of Levan, Utah. The location of the West and East Site are further described in section 104.2. The area of the Chicken Creek Mine is shown on Figure 105-1.

105.1.11. Property Boundaries of Surface Ownership

Plates 105-1A and 105-1B show the site location as it existed in 2006. The land affected by the mining operation of the West Site and adjacent properties are either privately owned or public domain (managed by the U.S. Forest Service). The land affected by the mining of the East Site and adjacent properties are privately owned by Levan Land Company, Pyramid Gypsum Corporation, and the U.S. Forest Service.

105.1.12. Physical Features

The West Site currently consists of an active open pit (Lower West Pit) and an unopened pit (Upper West Pit). Structures and facilities for the West Site (West Operation Facilities) are located as indicated on plate 105-1A, and include the following:

- Stockpiles
- Fuel storage tank
- Portable office trailers
- Mobile conveyor belts
- Trailer mounted rock crushers
- Portable toilet facilities

These structures are designed to be temporary and will be removed at the termination of mining activities within the West Pits. The area of the West Operation Facilities is moderately vegetated. A small seep was observed at the site during times of site visits, this will be discussed in more detail in section 106.8. Plate 105-1A shows current conditions of the West Operation Facilities.

The Lower West Pit has a natural slope of approximately 1.6H:1V with moderate vegetation. No intermittent or perennial streams or bodies of water exist within the Lower West Pit or adjacent area. Mining in the Lower West Pit has created two highwalls and benches. Access to the pit is via a gravel road from the canyon bottom. Portable toilet facilities are the only structures located at the Lower West Pit. Plate 105-1A shows current conditions of the Lower West Pit.

The Upper West Pit has a natural slope of approximately 1.6H:1V with limited vegetation. No mining has occurred at this pit. No intermittent or perennial streams or bodies of water exist in this area. No structures or roads currently exist at this site. Plate 105-1A shows current conditions of the Upper West Pit.

The East Pit has been mined and excavated to a limited extent to create an auxiliary stockpile and storage area, as well as for limited gypsum exploration. No further excavation or mining work will be performed in the East Pit until this NOI has been approved. The natural average slope of the area is approximately 1.5H:1V with several small cliff faces. The East Pit has a very thin soil veneer and little vegetation. Chicken Creek is located about 300 feet south of the pit. An ephemeral stream is a located within a ravine west of the proposed mine pit. However mine activities will not affect this ephemeral stream. A sedimentation pond has been built west of the pit access road. This pond was designed to provide sediment control for the access road and any storm water runoff that does not flow into the East Pit. A gravel road allows access to the East Pit from the canyon. No other facilities exist on the East Pit. Plate 105-1B shows current conditions of the East Pit.

105.1.13. Access Routes

Access for the Upper West Pit site will be provided through a gravel road that will extend from the Lower West Pit. The Lower West Pit is accessed via a gravel road from the canyon, as shown on plate 105-1A. Access for the East Pit is also provided via a gravel road. Access roads to the general area are shown on Figure 105-1 and Plates 105-2A and 105-2B.

105.1.14. Previously Disturbed Areas

The Chicken Creek Mine Lower West Pit is currently active and will remain active. No mining activities have occurred at the Upper West Pit. Future development plans for both the Lower and Upper West Pits are shown on Plates 105-2A and 105-2B.

The East Pit has been mined and excavated to a limited extent to create an auxiliary stockpile and storage area, as well as for limited gypsum exploration. No excavation or mining work will be performed in the east pit site until this NOI has been approved

The existing topography for both the West and East Pit sites is shown on Plate 105-1A and 105-1B, respectively. Future development areas are also depicted on Plates 105-2A and 105-2B.

105.2. SURFACE FACILITIES MAP

105.2.11. Proposed Surface Facilities

No permanent surface facilities will be located in the area of the Chicken Creek Mine. All equipment will be temporarily set up at the site during periodic mining and then removed when no longer needed. The Lower and Upper West Pits will only have portable toilet facilities on site. All office buildings, rock crushers, conveyor belt, fuel storage tank, and parking facilities will be located along the canyon road. Plate 105-1A provides information regarding the current location of equipment at the West Pit, and Plate 105-2A provides information for future location of equipment in the West Pit that will be developed with office buildings, rock crushers, conveyor belt, fuel storage tank, and parking facilities. See Plate 105-1B for information regarding current location of equipment at the East Pit, and Plate 105-2B for information regarding future location of equipment at the East Pit.

105.2.12. Proposed Disturbed Area Boundary

Plates 105-2A and 105-2B present the proposed disturbed area boundary for the West and East Pits and the access road area associated with the Chicken Creek Mine.

105.3. MISCELLANEOUS MAPS

Additional maps and cross-sections addressing re-graded slopes, water impounding structures, areas to be left unreclaimed, the hydrologic reclamation plan, baseline maps, reclamation maps, and other issues are referenced in the following sections of this application.

105.4. PHOTOGRAPHS

An aerial photograph of the West and East Pits is included on Plates 105-1A and 105-1B.

R647-4-106. OPERATION PLAN.

106.1. MINERAL TO BE MINED

The material to be mined at the Chicken Creek Mine is gypsum.

106.2. OPERATION TYPE

The proposed operation within the West Pits will involve expansion of the current active Lower Pit further into the ridge and commencing activities on the Upper Pit. The general proposed layout of the pits is noted on Plate 105-2A. The West Pits will be mined using a multiple bench approach. Extraction rates from the West Pits are anticipated to be approximately 60,000 tons of 3" to ½" gypsum and 12,000 tons of ½"- fines per year. These rates will vary depending upon mineral quality, plant production requirements, and the economics of mining and plant operation.

The proposed operation within the East Pit will involve expansion of the currently disturbed area further into the ridge face. The general proposed layout of the pit is noted on plate 105-2B. The East Pit will be mined using a multiple bench approach working from the top down. Extraction rates from the East Pit are anticipated to be about 65,000 tons of gypsum and 13,000 tons of fines per year, but will vary depending upon mineral quality, plant production requirements, and the economics of mining and plant operation.

Prior to extracting the resource, all the pits will be prepared to minimize and contain the impact of mining activity. New access roads will be built for the Upper West Pit and the East Pit. Topsoil will be stripped and stockpiled prior to disturbance. The existing access road for the Lower West Pit will be improved as necessary to accommodate increased equipment traffic for the Upper West Pit. Additional road improvements will take place at the East Pit as necessary to allow for increased equipment traffic. In addition, runoff and erosion control structures will be constructed. Berms and/or silt fences will be placed around the perimeter of the pit as needed in order to further isolate it from adjacent ephemeral washes. All the pits will be sloped toward the highwall to collect runoff and prevent sediment runoff from flowing off site, (see cross sections on Plates 105-2A and 105-2B and Figure 110-1).

Prior to disturbance of new areas, soils will be stripped and stockpiled. The pits will be mined by drilling and blasting the rock and removing the mineral. Highwall benches will be up to 40 feet tall, and will be constructed so that the orientation of the bedding of the bedrock enhances their stability. The maximum bench face angle will be approximately 90° and the maximum inter-bench slope angle will be 1H:1V (45°). The pits are designed so that drainage is concentrated towards the floor.

The final configuration of the Lower West Pit will have a floor elevation of approximately 6,260 feet and a top elevation of approximately 6,590 feet. When the limits of the pit are reached, as shown on Plate 106-2A, the pit will be graded and reclamation will commence.

The final configuration of the Upper West Pit will have a floor elevation of approximately 6,800 feet and a top elevation of approximately 7,120 feet. When the limits of the pit are reached, as shown on Plate 106-2A, the pit will be graded and reclamation will commence.

The final configuration of the East Pit will have a floor elevation of approximately 5,740 feet and a top elevation of approximately 6,590 feet. When the limits of the pit are reached, as shown on Plate 106-2B, the pit will be graded and reclamation will commence.

During reclamation, the pits will be blended into the surrounding topography at a maximum slope of 1.5H:1V for backfilled areas and 1H:1V for smoothed highwall faces. The backfilled slopes will be revegetated to match surrounding area and to increase stability. Retained highwall faces will blend with the natural exposed rock faces surrounding the area.

No stockpiles of unprocessed material will be retained on site following reclamation. Mined product will be processed as it is removed from the pits. Processing of the materials at both the West and East Sites will be limited to crushing and separation of fines and coarse gypsum using gravity and sieve systems. No further processing of the material will be performed at the mine sites.

No deleterious or acid-forming materials have been identified as occurring in this area. Additionally, no such materials are planned to be brought onto the sites or to be left on the sites in the future.

106.3 DISTURBED ACREAGE

Plates 105-2A and 105-2B show the extent of the disturbed area boundary for the Upper and Lower West Pits and East Pit and their corresponding access roads. The proposed disturbance will encompass 105.4 acres and contains the West Operation Facilities (15.9 acres), Lower West Pit (16.6 acres), Upper West Roadway (1.6 acres), Upper West Pit (17.8 acres) and the East Pit (53.5 acres). Additional acreage has been included in the disturbed boundary for an operations area at the base of the proposed pits as well as a buffer zone for rockfall/flyrock around the proposed pits. Table 106-1 breaks down the acreage of the existing and proposed disturbed areas.

106.4. NATURE AND TONNAGE OF MATERIAL MINED

The mineral deposits to be mined consist of high-quality gypsum. The quality of the minerals will determine the depth and extent of mining within the disturbed area boundary. For the current Sunroc process, the gypsum deposit concentration determines the areas suitable for mining.

Future mining production will be based on market and government agency requirements. Production rates can be approximated using the Air Quality Permit for Chicken Creek Mine which allows for up to 150,000 tons per year. The lower West Pit is capable of producing

1,950,000 tons or approximately 13 years. The Upper West Pit is capable of producing 1,900,000 tons or approximately 13 years. The East Pit is capable of producing 15,340,000 tons or approximately 102 years. However; these projections assume that each pit is mine individually. Assuming the East Pit will be mined at both the same time and at similar rates as the West pits, and that the Lower West Pit will be mined before the Upper West Pit, the East Pit has a mine life of 128 years and the Lower and Upper West pits both have a mine life of 26 years.

No waste materials will be generated as part of the mining. Therefore, the mining operation currently contains no major waste disposal areas. Trash disposal is discussed in Section 106.9.

106.5. SOIL MATERIALS

Information contained in Appendix 106-1 indicates that, within the disturbed and adjacent areas of the Upper and Lower West Pits, the soils generally consist of Xeric Torriorthents-Rock Outcrop Complex, Steep soil type. Claim 4W, south of Upper West Pit, contains Lundy-Rocky Outcrop Complex with 30% to 70% slopes. No mining activities will take place within Claim 4W. The West Operation Facilities consist of Rofiss Gravelly Clay Loam, 4% to 15% Slopes and Xeric Torriorthents-Rock Outcrop Complex, Steep. The East Pit consists of Cumulic Haploxerolls, sloping, Rofiss gravelly clay loam with 4% to 15% slopes, and Xeric Torriorthents-Rock outcrop complex, steep. No mining activities will take place within Claim 1E, and mining activities within Claim 2E will be limited to the east-most portion.

Typical descriptions of the soils are given in Appendix 106-1. Figures 106-5A and 106.5B depict the location of surficial soils based on maps from H.E. Davis Construction LLC in the vicinity of the existing and proposed mining areas.

106.6. SOIL PROTECTION AND REDISTRIBUTION PLAN

Prior to future disturbances of the resource at the Chicken Creek Mine, the areas to be disturbed will be stripped of the available topsoil materials. Based on site reconnaissance, the soils existing on-site are thin and variable in depth. In some portions of the site, the bedrock is exposed and no soils are present. All reasonable efforts will be made to salvage the available soil materials, and stockpile these materials prior to mining.

Removal of topsoil will be accomplished by use of a dozer scraping the available topsoil into a pile. Due to the limited soil resource, all available soil materials will be required for reclamation efforts; therefore, no segregation of the soil layers will occur. Once stacked, the soil can be moved to a safe location using a loader and dump truck. The soil will be temporarily stockpiled, posted as soil material, and revegetated to prevent wind and water erosion.

For estimating purposes, the thickness of the stripped material is assumed to be 6 inches. For location of topsoil stockpiles see Plates 105-2A and 105-2B. The Operational Facilities, access road for the Lower West Pit and existing Lower West Pit have been disturbed and no topsoil from these areas has been salvaged. Based on the extent of the proposed disturbance areas for the Lower West Pit excluding existing disturbed area, the soil salvage volume for the Lower West Pit will be approximately 4,190 CY. Based on the extent of proposed mining at the Upper West Pit and access road area, the soil salvage volume is estimated to be 15,670 CY. Based on the extent of the proposed disturbance areas for the East Pit excluding existing disturbed area, the soil salvage volume for the East Pit will be approximately 39,920 CY. Stockpiles at the pit sites will be added to as mining activities continue.

Soils will remain in the stockpiles until the regraded slopes are ready for redistribution and placement of the stockpiled soil materials. Topsoil redistribution will be handled as described in Section 110.5.

106.7. VEGETATIVE BASELINE

According to Appendix 106-2, vegetation in the vicinity of the West Operation Facilities consists of a mixture of Riparian and Sagebrush/Grass near Chicken Creek. The remaining area of the West Operation Facilities consists of a mixture of Gambel's Oak, Mountain Mahogany, and Slender Wheatgrass/Mountain Mahogany. As indicated in Figure 106-7A, vegetation in the vicinity of the Lower West Pit consists of mainly Mountain Mahogany with a little of Pinyon-Juniper forest. Vegetation at the Upper West Pit consists of a mixture of Gambel's Oak, Mountain Mahogany, and Pinyon-Juniper forest.

In general, vegetation in the vicinity of the East Site is sparse. Figure 106-7B indicates that pre-mining vegetation for the existing pit area consists of Pinyon-Juniper forest with a small amount of Gambel's Oak along the top of the ridge. The area between top of the ridge and the bottom of the pit site consists of Mountain Mahogany. The bottom of the pit site is mostly Slender Wheatgrass/Mountain Mahogany with a small amount of Riparian vegetation near Chicken Creek. No mining activities will take place within Claim E1 and limited activities will occur within Claim E2. As a result, only the east third of Claim E1 has had a vegetation survey, extending a distance of approximately 700 feet outside of proposed disturbed area.

106.8. GEOLOGY AND HYDROLOGY BASELINE

Both the West and East Sites are located in the Arapien Shale layer which dates to the Middle Jurassic (Hylland and Machette, 2008). Exposed surface of the Chicken Creek area is difficult to age due to landslides along the steep slopes of the canyon walls (Hylland and Machette, 2008). Pit areas will be located in deposits of gypsum lenses and beds (Auby, 1991). Within these beds gypsum is the predominant mineral with some selenite and satin spar (Auby, 1991).

The Pigeon Creek fault line runs parallel to the San Pitch Mountains along the base of the Pitch Mountains. The Pigeon Creek fault has a vertical slip rate of between 0.3 ± 0.1 mm/yr and fault scarps of 0.9m to 4.3m. These scarps are observed 1,500 feet west of the Chicken Creek Mine site and are not anticipated to affect the mine. (Hylland and Machette, 2008)

Chicken Creek is a tributary to the Sevier River and it is hydrologically disconnected into two surface water sections. The upper Chicken Creek originates in the Manti La-Sal National Forest and currently terminates near the Forest Service boundary (Utah Division of Water Quality, 2008). Lower Chicken Creek originates in a wet meadow complex between Chicken Creek Reservoir and the town of Levan via a number of flowing groundwater wells and springs. These sections were historically connected, but due to irrigation diversions, surface flows rarely contain sufficient water to connect and discharge to the Sevier River.

Ground water in the valley drainage occurs in the unconsolidated basin-fill deposits (Burden et al., 2004). Most of the recharge to the ground water reservoir occurs on the eastern side of the San Pitch Mountains. Ground water moves to the lower part of the valley and to eventual discharge points at ground water wells and springs. A group of springs occurs at the foot of the alluvial fan of Chicken Creek (Meinzer. O. E, 1911).

According to published literature in the adjacent area within the canyon bottom (Burden et al., 2004), the flowing wells range in depth from about 80 feet to more than 300 feet.

Groundwater occurs in the basin-fill deposits under both water-table and artesian conditions. The valley fill consists primarily of interfingered layers of clay, silt, sand, and gravel. Sediments are generally coarser grained in alluvial fans along the mountain fronts and finer grained in the central portions of the creek.

A small seep exists in the area above the West Operation Facilities (see plate 105-1A). During a site visit on October 1, 2008 the seep consisted of a moist area in the soil and no standing water. From the site visit it appears that the seep issues from a bedding plane between a layer of gypsum above and sandstone below. If significant flow occurs from this seep in the future, it will drain into a channel then into the sediment pond upstream from the West Operation Facilities. These flows are expected to remain minimal and will most likely not reach the sediment pond.

A small seep formerly existed within the Lower West Pit; however, during a slide of the active mine wall this seep was eliminated. A clay layer between the gypsum layers acted as a natural water barrier trapping water and causing the small seep. Mining activities removed much of the supporting material along this clay layer causing the material to slump into the bottom of the pit. No additional seeps have appeared at this location suggesting that the pit seep had a very localized recharge and discharge area.

On Monday, May 4th, 2009, EarthFax Engineering conducted both a geologic and hydrogeologic evaluation of the Tunnel Spring and Rose Bush Spring areas. The purpose of this evaluation was to determine if the current mining activity being conducted by Sunroc will adversely affect these water recourses. Both springs are currently being captured below the ground surface of their historical point of emersion. Tunnel Springs consists of three subsurface collection catchments, the closest catchments is over 1,200 feet west of the West Operation Facilities. Rose Bush Spring consists of two subsurface collection catchments; the closest catchment is over 700 feet west of the proposed East Pit operation facilities location. Rose Bush Spring is also on the south side of Chicken Creek, making future mining impacts at this spring null.

Both springs emerge near stream level, at the base of relatively small catchment basins. Tunnel Spring catchment basin is hydrologically separated by minor ridge divides from any current or future Sunroc mining plans. Both springs originate and emerge from the geologic unit known as the Arapien Shale (Jurassic). The Arapien Shale is also the host for all regional Gypsum deposits, including those which are mined by Sunroc. Due to the incompetent, fissile nature of the Arapien shale unit, with its relatively low clay content, and its minor, fractured limestone inclusions, groundwater is able to flow quite freely throughout this unit. Groundwater in this unit also preferentially follows subsurface within the confines of existing surficially contoured drainage networks. Based on field observations and local hydrogeologic behavior, it is unlikely current or future local mining activity conducted by Sunroc with adversely affect either the Tunnel Spring or Rose Bush Spring water resources.

According to records from Jason Worwood the Utilities Manager for the City of Levan during the fall, winter, and spring Rose Bush and Tunnel Springs provide all culinary water for the City of Levan. During the summer a small well provides a supplemental supply, due to the varied flow rates from the springs it is not possible to calculate the percent of water supplied by the well. According Utah Division of Water Rights Rose Bush Spring historically produces 0.501 cfs or roughly 225 gallons per minute and Tunnel Spring historically produces 0.78 cfs or roughly 350 gallons per minute. However; according to Jason Worwood recorded flow rates can vary depending on the year by a factor of 10. The City of Levan and Sunroc are working together to update Rose Bush and Tunnel Springs with flow meters to establish a more consistent flow baseline. This will allow the City of Levan and Sunroc to detect immediate changes in flow rates that may be caused by mining activities.

106.9. FACILITIES LAYOUT

The facilities at the Chicken Creek Mine include seven general areas: the Lower West Pit, the Upper West Pit, the East Pit, West Operation Facilities area, and access roads for Lower West Pit, Upper West Pit, and East Pit (Refer to Plate 105-2A and 105-2B). There will be no permanent structures at the mine, and processing on site will be limited to crushing materials and screening.

Lower West Pit

Future mining in the Lower West Pit area will involve the construction of multiple 40-foot highwalls and 40-foot benches. The benches will daylight on the west of the pit, and will be blended at a 1H:1V (45°) slope into the natural ground on the north, east, and south of the pit.

Silt fencing and berms will be installed as needed around the perimeter of the pit. The pit floor will be sloped so that it directs runoff towards a sedimentation pond on the east side of the pit area, thereby preventing runoff and sediment discharges from adversely affecting adjacent undisturbed areas. As the pit area is mined, the slope northeast toward the highwalls and away from the undisturbed area will be maintained. Benches will also be sloped to drain toward the face of the highwalls. The only facilities planned for the Lower West Pit are an access road extending to the Upper West Pit, the operational facility adjacent to the canyon road, and portable toilet facilities. The road and general layout of the Lower West Pit are shown on Plate 105-2A.

Upper West Pit

Future mining in the Upper West Pit area will be the same as the Lower West Pit. Runoff from the pit floor will be directed towards a sedimentation pond near the center of the pit area, thereby preventing runoff and sediment discharges from adversely affecting adjacent undisturbed areas. As the pit area is mined the slope north and east toward the highwalls and away from the undisturbed area will be maintained. Upper West Pit facilities will be the same as the Lowe West Pit. The road and general layout of the Upper West Pit are shown on Plate 105-2A.

West Operation Facilities

The West Operation Facilities is located adjacent to the canyon road. This area will be used for stockpiling a portion of the topsoil from the Lower West Pit and West Operation Facilities. The area will also include two piles of coarse and fine gypsum. Gypsum stockpiles will vary in size as the crushed gypsum is hauled off site for further processing. Two existing sediment ponds on the west and east side of the West Operation Facilities will be modified to control runoff. The facilities layout for the West Operations Facility is shown on Plate 105-2A.

East Pit

Future mining in the East Pit will be similar to the West Pits. Broad channels within the pit floor will direct runoff into sediment ponds located on the east and west side of the pit area, thereby prevent runoff and sediment discharges from adversely affecting adjacent undisturbed areas. As the pit area is mined the slope north toward the highwalls and away from the undisturbed area will be maintained. Benches will also be sloped to drain toward the face of the adjacent highwall. To allow access to the top of the East Pit an access road will be constructed along the west side of the East Pit. As the pit expands the road will be shortened and reclaimed. Facilities planned for the East Pit consists of rock crushing and conveying equipment, temporary piles of product and fines, portable toilet facilities, parking areas shown on plate 105-2B.

The East Pit facilities will be located within the southwest area at the bottom of the East Pit. These facilities will consist of a similar setup to the West Operation Facilities. Stockpiled topsoil will be located within the southeast area of the East Pit and will increase in size as mining operations continue. An existing sediment pond will be modified and an addition pond will be constructed within the East Pit floor to control runoff. The facilities layout for the East Operations Facility is shown on Plate 105-2B.

Drainage Control

Drainage controls will be provided at all pits and the West Operation Facilities. As indicated in Appendix 107-2, sedimentation ponds will be constructed to retain runoff resulting from the 10-year, 24-hour storm. Spillways on all ponds will be designed to safely convey the runoff from the 10-year, 24-hour storm followed by a 25-year, 6-hour storm. In addition sediment ponds and channels will be designed to handle a 100-year, 30-minute storm. These storms are more consistent with the Western United States. Sediment control ponds for the Lower West Pit, West Operational Facilities, and the East Pit will consist of improving existing ponds and the construction of additional ponds. As mining operations begin at the Upper West Pit, a sediment pond will be constructed. Additionally a new pond will be constructed on the east side of the pit floor of the East Mine. The large undisturbed area upstream of the West Operation Facilities will be diverted around the facility. For further design information, see Plates106-1A and 106-1B.

All pond locations shown on Plates 106-1A and 106-1B are approximate. Elevations and locations will be adjusted as needed to fit site conditions; however, dimensions will be retained.

Runoff-control channels will be constructed along all roadways. Storm water will be directed by these channels into sediment ponds. For further design information see Plates 106-1A, 106-1B, and 106-1C and Appendix 107-2.

Access Roads

Existing access roads will be improved, and additional road segments may be constructed to provide access to the pits. Typical road sections are detailed in Figure 106-3. Unless they are located in areas that will eventually be mined through, roads will be constructed with minimal cut and fill grading.

106.10. EARTH MOVING OPERATIONS INFORMATION

The total volume of material to be mined is estimated to be 1,950,000 CY in the Lower West Pit, 1,900,000 CY in the Upper West Pit, and 15,340,000 CY in the East Pit.

R647-4-107. OPERATION PRACTICES.

107.1. PUBLIC SAFETY AND WELFARE

107.1.11 Shafts

There will be no shafts associated with the Chicken Creek Mine facilities.

107.1.12. Waste Disposal

Trash and other debris will be collected and hauled from the Chicken Creek Mine to an approved landfill or transfer station by the Ace Disposal Company as needed. Sewage will be collected in portable toilets during the temporary mining periods and hauled off as needed. All waste materials associated with the mining operation will be properly disposed of in approved off-site locations.

107.1.13. Exploration Plugging Program

No exploration has been conducted by Sunroc on and around the mine area using techniques that require capping as explained in R647-4-108.

107.1.14. Warning Signs

Access to the site is off a maintained graded gravel road. Warning signs will be posted where the access road diverges from the maintained gravel road toward the mine. Warning signs will be posted around the perimeter of the mine to indicate to the public that mining and blasting occur within the mining area. All traffic on roads near site will be temporarily stopped during blasting operations. For more information on blasting plan see Appendix 109-4.

107.1.15. Highwall and Excavation Protection

Highwalls or significant excavations will exist on the property. The pit will have berms located at the top of the highwalls as needed. To reduce the safety hazard, the final slopes of the highwall will be reduced to 1H: 1V or less as defined by R647-4-111.7.

107.2. DRAINAGES

The Upper West Pit is located at the top of two ridge lines; therefore runoff into the pit is limited. The pit will be constructed so it is hydrologically isolated from adjacent drainages. Berms and silt fencing will also be installed around the perimeter of the pits as needed. No intermittent or perennial stream channels appear to exist within the pit. A sediment pond, West Pond #1 (see Plate 106-1A), will be constructed to contain runoff from the pit. As the pit is mined the elevation of West Pond #1 will change, however, the size will remain the same. Runoff from the emergency spillway will flow down a natural channel that will be improved into the ephemeral stream located west of the pit. From this stream runoff will follow the historic path off site.

The Lower West Pit site is also located similarly to the Upper West Pit. The pit will be constructed similar to the Upper West Pit. No intermittent or perennial stream channels appear to exist within the pit. However, an intermittent or perennial stream is located down stream of the pit. A sediment pond, West Pond #2 (see Plate 106-1A), will be constructed to contain runoff from the pit. As the pit is mined the elevation of West Pond #2 will change, however, the size will remain the same. When mining activities are finished on the Lower West Pit a channel will be constructed along the access road for the Upper West Pit. This access road will be constructed along the pit wall. This channel will direct runoff from the access road for the Upper West Pit to West Pond #2. Runoff from the emergency spillway will flow down a channel into an intermittent or perennial stream located north of the pit. From this stream runoff will enter a pipe and flow under the West Operation Facility to an outlet 100 feet from Chicken Creek. (See Plate 106-1A)

The West Operation Facilities and Lower and Upper West Pit access road is located generally at the bottom of a draw. Therefore, the drainages flowing into the facilities and access road are large. An existing pond, West Pond #3 (see Plate 106-1A), upstream of the West Operation Facilities will be improved to detain runoff from the upper part of the pit access road. West Pond #3 will be located within an intermittent or perennial stream. A pipe will be located immediately upstream of West Pond #3 to channel upstream runoff under facilities allowing runoff to daylight downstream of the facility. Berms and silt fencing will also be installed around the perimeter of West Pond #3 and channels as necessary. During Reclamation this stream will be restored.

Two additional ponds will be located within the West Operation Facilities. An existing pond, West Pond #4 (see Plate 106-1A), located along the northwest side of the existing parking area, above the exit to 1st Street will be modified to retain runoff. West Pond #4 will intercept runoff from the lower part of the pit access road and the west half of the facilities. An existing pond, West pond #5, located along the northeast side of the facilities, above the entrance from 1st Street will be expanded to comply with design regulations. West Pond #5 will intercept runoff from the east half of the facilities and overflow from the pond located upstream from the facilities. (See Plate 106-1A)

The East Pit and Operation Facilities are located within the pit are located entirely within its own watershed. A ridge on either side of the pit will contain runoff from the active mining area. An existing pond, East Pond #1, located along the north side of Chicken Creek and west of the access road to the East Pit will be expanded to comply with design regulations. West Pond #1 will collect runoff from the west third of the pit area. An additional pond, East Pond #2, will be constructed within the east side of the pit floor to collect runoff from the east two thirds of the pit. The pit floor will be sloped to allow runoff to flow over the surface into two broad flat channels along the west and east sides of pit floor. These channels will have a 10:1 horizontal:vertical sides, 1 foot depth, and the east channel will have a 10 foot wide bottom to allow vehicles and equipment to travel across the channels. The west channel will flow to the west side of the access road and then southwest into East Pond #1. The east channel will flow to the east side then into the East Pond #2. The overflow from East Pond #1 will flow directly into Chicken Creek. The overflow from East Pond #2 will flow into a channel along the north side of the canyon road then into Chicken Creek. (See Plate 106-1B)

All pit floors will be constructed to slope toward the ponds. The ponds have been designed to contain the discharge volume from the 10-year, 24-hour and the 100-year, 30-minute rainfall events, noncontiguous, during operating conditions, as calculated by the Soil Conservation Service (SCS) Method using HydroCAD 2005 software. The ponds emergency spillways were designed using FlowMaster v6.0. The pond spillway will also pass the peak flow from the 25-year, 6-hour storm event immediately following the 10-year, 24-hour event. Appendix 107-2 presents the calculations for sizing the sediment and all other runoff control structures.

107.3. EROSION CONTROL

All sedimentation ponds within the Upper and Lower West Pits, West Operation Facilities, and East Pit will be constructed to accommodate the sediment yield from the pit area during operational conditions. Total annual sediment yield for the Upper West Pit (West pond #1) will be 423 cf. Total annual sediment yield for the Lower West Pit (West pond #2) will be 262 cf. Total annual sediment yields for the West Operation Facilities and access roads (West ponds #3, #4, #5) will be 155 cf, 62 cf, 98 cf, respectively. Total annual sediment yield for the East Pit (East pond #1 and #2) will be 345 cf and 980 cf, respectively.

Erosion volumes were calculated using a version of the Universal Soil Loss Equation (USL) that has been modified for use in Utah (Isrealson et al, 1984). Erosion volume calculations are detailed in Table 107-3.

107.4. DELETERIOUS MATERIALS

Other than excavation, crushing and separation of the gypsum into product (3" to ½") and fines (less then ½"), no other processing will occur at the West or East Site. Therefore, it is anticipated that no deleterious materials will be generated or used on the West or East Sites. Any materials that are used at either will be properly disposed of and/or stored to ensure that adverse environmental effects are either eliminated or controlled to the extent possible.

107.5. SOILS

Soils on the mine permit area will be protected in accordance with the requirements of Section 106.6 of this application. Existing soils will be stripped prior to disturbance in an area.

107.6. CONCURRENT RECLAMATION

Due to the expansive nature of the mining technique at both the Upper and Lower West Pits and the East Pit no concurrent reclamation will occur within the pit areas themselves. Disturbed areas that become unnecessary will be reclaimed as needed.

Due to large size and purity of the gypsum deposit and plant production rate, the mine can operate for over 100 years. However, due to permitting limitations and changes within permitting regulations this schedule is expected to change. This schedule is based on current production rates and mining techniques. These requirements may change with market conditions and plant production requirements.

R647-4-108. HOLE PLUGGING REQUIREMENTS.

No exploration holes have been drilled in the mine area. No oil and gas wells, water production wells, or other boreholes have been identified in the mined area. If any holes are drilled at the site, they will be plugged and abandoned in accordance with DOGM plugging guidelines.

R647-4-109. IMPACT ASSESSMENT.

109.1. HYDROLOGY

The potential impact to the surface water systems from the Chicken Creek Mine is increased sediment yield from the Upper and Lower West Pits and East Pit, roadways, and West Operation Facilities. For all of the pits, this potential impact is minimized by the gently sloping the floor of the mine pit which drains into the runoff control structures detailed in section 107.2 of this document. Other sedimentation ponds will be modified to control runoff from the West Operation Facilities. Furthermore, sedimentation ponds have been designed to contain runoff volume from a 10-year, 24-hour storm event in addition to 1 year of sediment discharge. Finally, the sedimentation pond will contain a broad-crested weir spillway that will convey the peak flow from the 25-year, 6-hour storm event immediately following a 10-year, 24-hour event. Channels have also been designed to safely convey a more intense 100-year, 30-minute storm.

109.2. THREATENED AND ENDANGERED SPECIES AND HABITAT

According to information from the National Forest Service one Golden Eagle nest is located within one mile of the Chicken Creek Mine sites and three nests are within ½ mile of the sites, see Figure 109-2. According to a report prepared by Mt. Nebo Scientific, Inc. dated August 9, 2000 the Golden Eagles are the only threatened, endangered or sensitive species that are known to exist within or adjacent to the existing or proposed disturbed area associated with the Chicken Creek Mine. According to this report five golden eagle nests existed within one mile of the site in 2000; however the National Forest Service has recorded only four nests. This report is presented in Appendix 109-1. The golden eagle nests within ½ mile of the site will be observed by the U.S. Fish and Wildlife Service for one week during golden eagle courtship and nesting building periods, February 1 to March 1 depending on weather. During this week each nest shall be observed for a four hour period each day to verify occupancy of the nests, for more information see Golden Eagle Monitoring Plan in Appendix 901-1. Mining activities for Chicken Creek Mine will be modified to accommodate golden eagle nesting.

Due to the infrequent operations at the site, no significant impacts to wildlife species are expected from mining operations in the area. To accommodate winter grazing of elk, deer, and other animals the mining will stop operations from the 15th of November to the 1st of March.

As the existing disturbed area expands, vegetation will be removed. Vegetation will be re-established in the area upon reclamation, as outlined in Section 110 of this permit application. Future reclamation activities will, over time, aid in the restoration of vegetative communities and wildlife habitats for those areas of the mine that are no longer needed for mine operations.

109.3. SOILS

Soil resources from the reclaimed pit areas and all additional disturbed areas will be salvaged, stockpiled, and vegetated for future reclamation. Future impacts to the soil resources of the area will occur. However, they will be temporary and will assist in future reclamation of the site.

109.4. SLOPE STABILITY, EROSION, AIR QUALITY, AND PUBLIC HEALTH AND SAFETY

The West Pits and the East Pit will contain a benched high wall with a maximum anticipated bench height of 40 feet. The benches will be constructed so that the orientation of the bedrock (strike and dip) enhances their stability. These areas will be sloped at a maximum slope of 1.5H:1V. In the benched areas, the maximum interbench slope will be 1H:1V, with bench face angles of approximately 90°. The natural geological formation of gypsum at the site includes stable cliff faces and steep slopes that exceed 100 feet. These gypsum deposits are several hundred feet thick and have few fissures or cracks within them. Furthermore, the Arapien Shale layer appears to be horizontal at the Chicken Creek Mine location (Auby, 1991). Slope stability will be monitored during pit construction and modified as necessary to create stable slopes. In the benched area, the post-reclamation slopes will be reduced to a maximum angle of 1.5H:1V for added stability and revegetation.

For a copy of the Air Quality Permit see Appendix 109-4. According the Chicken Creek Mine Air Quality Permit 150,000 tons of material can be mined and processed at the facility per year. To control dust not related to crushing and screening rock water trucks will be used daily or as needed on all pit and facility access roads on site and in all pit and parking areas. Therefore, no dust problems are anticipated from the operation.

Public health and safety are protected by posting warning signs and placing berms at the top of all highwalls and access roads as needed. During blasting operations bilingual signs, barricades, and guards will be placed around the blast area to prevent public entry. Warning and all clear sirens will also be used. All traffic on roads near site will be temporarily stopped during blasting operations. It is anticipated that no magazines or related explosive equipment will be stored on site. All federal, state, and related regulations will be followed if explosives are stored onsite. All federal, state, and related regulations will be followed during blasting operations, see blasting plan within Appendix 109-4.

109.5. MITIGATION ACTIONS

As discussed in this application, the actions proposed to construct the mine will help to minimize the impacts to the surface water system, minimize the loss of additional soil materials, and will, over time, aid in the reestablishment of vegetative communities and wildlife habitats.

R647-4-110. RECLAMATION PLAN.

110.1. CURRENT AND POSTMINING LAND USE

Prior land use(s):

Wildlife habitat and mining

Current land use(s):

Wildlife habitat and mining

Possible Projected or Prospective future land uses(s):

Wildlife habitat and recreation

110.2. RECLAMATION DESCRIPTION

General Description

This section presents a conceptual plan to reclaim the affected lands within the mine permit boundaries and to blend the affected area into the surrounding undisturbed area once mining operations are completed.

Following the completion of mining operations, the mine will be reclaimed to meet the post-mining land use. Plates 110-1A and 110-1B present the proposed configuration of the final reclaimed pit areas. The edge of the bench will be blasted off and used as fill material for the bench surfaces. Blasted bench edge will have a slope of 1H:1V and a fill slope on the benches of 1.5H:1V, see Figure 110-1. Fill stability for bench areas was calculated with a 1.3 factor of safety to be 40° or 1.2H:1V, see Figure 110-1 and Slope Stability in Appendix 111-2.

All runoff control structures will be reclaimed so that the site is stable and free-draining. As benches are filled and cut to achieve a stable slope and as roads are regarded all berms open diversion ditches and ponds will be reclaimed in a stable and free-draining way. Some channels will be constructed to prevent surface erosion as vegetation is established. These channels will also prevent runoff from entering the canyon road and washing roadway sediment into Chicken Creek.

Except for the benches that will be covered with fill, all disturbed areas will be ripped when mining has been completed. Dozers will be used to regrade all slopes to their reclamation configurations. The slopes will then be covered with soil and reseeded.

All roads will be reclaimed following mining. Some roadways will be needed during and after reclamation for access to periodically inspect the site. Once a road is no longer needed, it will be reclaimed. Roads will be reclaimed by ripping or disking the road surface. Some re-contouring will likely be required to blend the road into the surrounding topography. All reclaimed roads will be reseeded.

It is likely that many technical, economic and political changes will occur between now and the time when reclamation begins. Sunroc retains the right to negotiate changes in the plan prior to reclamation to incorporate new technology or to avoid unreasonable economic burden.

Revegetation

See Section 110.5 for revegetation description.

110.3. SURFACE FACILITIES TO REMAIN

All existing and proposed structures will be temporary and will be removed after mining activities have ceased. The pits, roads, and parking areas will be re-contoured and reseeded.

110.4. DELETERIOUS MATERIALS

No deleterious materials will be used on-site and none will remain following mining.

110.5. REVEGETATION PLANS

The rocky high desert terrain surrounding the proposed Chicken Creek Mine facility is sparsely covered with shrubs, grasses, and Gambel's Oak, Mountain Mahogany, and Pinion-Juniper forest (see Section 106.7). The primary uses of the land are wildlife habitat and mining. The following plan for revegetating disturbed areas at the Chicken Creek Mine will aid in returning the land use to an appropriate post-mining condition.

The area will be graded to approximate final contours, and then ripped to relieve compaction. Ripping will be completed to a maximum depth of 2 feet. Final ripping depths will be determined by the materials being ripped, to prevent incorporation of less desirable soil/rock into more productive materials.

Following ripping, stockpiled soil will be applied to the ripped surface and left in a roughened state. Based on amount of stockpiled topsoil from section 106.6 anticipated stockpiled topsoil depths for the West Site will be 3" and the East Site will be 6". Rocks of varying size will be placed within the surface to allow for natural appearance and moisture accumulation. Following placement of the stockpiled soil and prior to application of the reclamation seed mixes, hay and/or straw mulch or other suitable substitute with high organic matter content, will be incorporated into the soil media at a rate of 2 tons per acre. This will be done to improve soil structure for aeration purposes, increase micropore space, and improve the water-holding capacity of the soil. Incorporation of this mulch will occur either by plowing along the contour, deep gouging, or a combination of these methods.

On slopes steeper than 2.5H: 1V, once the soil media are emplaced and either after or during incorporation of the initial mulch (depending on the method); the surface soil will be gouged across the slope to a depth of approximately 12 inches using the bucket of a trackhoe. The purpose of this gouging will be to reduce compaction of the upper soil and to increase water infiltration.

Care will be taken to avoid deep gouging into poorer quality materials underlying the soil materials. While it is recognized that the deep gouging process may extend below the thickness of the soils, the materials which will underlie the soil layer are neither acid- nor toxic-forming. Therefore, if these materials are exposed, they will not create revegetation concerns. Furthermore, wind and water transport of the adjacent soil will soon cover any exposed subsoils.

Table 110-1 shows a tentative seed mix that will be used and the rate at which each type of seed will be planted. The seed mix was recommended by the U.S. Bureau of Land Management (BLM). All seeds will be incorporated with a small amount of mulch and applied by hydroseeding or range drilling equipment, depending on slope and other considerations. All seeding will take place during the fall of the year. Seeded areas will not be irrigated to prevent shallow rooting and decreased drought tolerance.

Following seeding, the disturbed areas will be mulched with an organic mulching material. Application will be initiated at the top of the slope and working downhill. Organic mulch will be applied at the rate of 1 ton per acre and anchored with a tackifier.

No grazing is expected to affect the mine area prior to bond release. Wildlife and stray cattle may adversely impact revegetation efforts. If grazing adversely affects revegetation efforts, Sunroc will develop plans with the land management agency to protect establishment of the vegetation.

Revegetation success will be evaluated based on Rule 111.13, of the DOGM General Rules and Regulations, which stipulates that revegetated lands must achieve a surface cover of at least 70% of the representative vegetative communities surrounding the mine and that the initiated vegetation must survive for three growing seasons without irrigation or soil amendments. To verify the prescribed level of cover and species diversity, these parameters will be measured using the point count method at the end of the third growing season

No erosion matting is proposed for the reclaimed surfaces.

110.6 STATEMENT OF CONDUCT

The Operator pledges to reclaim the site as outlined above.

R647-4-111. RECLAMATION PRACTICES.

111.1. PUBLIC SAFETY AND WELFARE

No shafts or tunnels are anticipated as part of the mining activities on this site.

All trash, extraneous debris and other materials will be removed periodically from the site as part of the final site clean up and hauled to a landfill approved for the acceptance of such waste, see section 107.1.12.

Currently, there are no exploration holes at the Chicken Creek Mine site. Any exploration holes, which remain following mining, will be appropriately abandoned pursuant to DOGM Guidelines.

No hazardous highwalls will remain following reclamation. The proposed reclamation will replace highwalls with regraded slopes as discussed in Section 110.2.

The Chicken Creek Mine is located within a roadless area. All roads currently used or to be build for access to mining activities will be removed, regarded, and revegetated after mining activities have ended.

Procedures outlined in sections 107.1.14 and 109.4 and Appendix 109.4 will be followed during blasting.

111.2. DRAINAGES

The all pits will be reclaimed so that drainage which flows through the mine area will drain in a stable manner. All ponds, berms and silt fencing that were used to divert runoff from the site during operations will be removed or reclaimed. Materials from the diversion berms will be used in the reclamation to ensure that the reclaimed topography blends with the original ground surface. Refer to Plates 110-1A and 110-1B for a Reclamation Drainage Boundary Map.

111.3. EROSION CONTROL

During initial reclamation of the West Pits, all drainage from the site will be directed with berms and silt fences to the historic drainage paths. During the final stages of reclamation activities, after the area becomes erosionally stable, and vegetation is reestablished, the berms and the silt fences will be removed.

During initial reclamation of the East Pit, all drainage from the site will be directed towards East Pond #1. As East Pond #2 is regraded a channel will extend from the end of Channel #2 to East Pond #1. If it is considered necessary, additional silt fencing may be installed in specific areas to reduce sediment loss from the site. During the final stages of reclamation activities, after the area becomes erosionally stable, and vegetation is reestablished, East Pond #1 will be reclaimed and the silt fences will be removed.

111.4. DELETERIOUS MATERIALS

All materials used in the reclamation activities will be properly disposed of and/or stored to ensure that adverse environmental effects are either eliminated or controlled to the extent possible. As discussed previously, no materials have been or will be stored on the site that are known to cause a hazard to the environment.

111.5. LAND USE

Completion of reclamation will result in the site area being in a condition that is capable of supporting the proposed post-mining land use (see Section 110.1).

111.6. SLOPES

No waste or spoil piles will be left as part of the reclamation activities. Therefore, no safety or erosion hazard will exist on-site.

111.7. HIGHWALLS

As part of reclamation activities, the highwalls at all the pits will be reduced to a maximum slope of 1.5H:1V in benched areas and 1H:1V in non-benched areas, see Figure 110-1. During operations, berms will be placed along the perimeter of the highwall to prevent access.

111.8. ROADS AND PADS

All roads that are not part of the post-mining land use will be reclaimed in accordance with Section 110.2.

111.9. DAMS AND IMPOUNDMENTS

As shown on Plate 110-1A, all sedimentation ponds at the West Site will be backfilled during the final stages of reclamation. At the Upper West Pit an engineered reclamation channel will be constructed from the bottom center of the wall, across the pit floor, in order to convey any discharge from the pit area to the historic drainage path. All disturbed areas will be left in a stable, free-draining condition.

At the Lower West Pit two engineered reclamation channels will be constructed in the vicinity of the bottom center of the pit, across the pit floor, and along the abandoned roadway, in order to intercept any discharge from the pit area and access road. This channel will direct all runoff into the historic drain path toward the West Operation Facilities.

The sedimentation ponds at the West Operation Facilities will be backfilled during the final stages of reclamation. Several engineered reclamation channels will be constructed to intercept runoff and direct it toward Chicken Creek and around 1st Street.

For Reclamation layout and details for East Pit area see Plate 110-1B. East Pit #2 will be backfilled during the final stages of reclamation and a channel will be constructed from the spillway of East Pond #2 to East Pond #1. As vegetation and soil stability are established East

Pond #1 will be backfilled and an engineered reclamation channel will be constructed to convey any discharge from the East Pit area to Chicken Creek.

111.10. TRENCHES AND PITS

All trenches and pits resulting from the mining activities will be reclaimed to a maximum slope of 1.5H: 1V.

111.11. STRUCTURES AND EQUIPMENT

All temporary structures, equipment, and debris will be removed or buried.

111.12. TOPSOIL REDISTRIBUTION

Salvaged soils in the mine permit area will be redistributed in accordance with Section 110.5 of this application.

111.13. REVEGETATION

The revegetation seed mix includes a mix of native and introduced perennial species which are suited to grow on the reclaimed site, provide basic soil and watershed protection, and support the post-mining land use (see Section 110.5). The revegetation efforts will be considered complete when the vegetation stand has survived three un-supplemented growing seasons and has achieved a cover of 70 percent of the pre-mining ground cover. Once these conditions are met, Sunroc will request the Division to release the bond for the site reclamation.

R647-4-112. VARIANCE.

No variances are requested.

R647-4-113. SURETY.

113.1. INTENT TO PROVIDE SURETY

Once the plans for the facilities are approved, Sunroc will post a surety to cover the reclamation of the facilities.

113.2. SURETY COORDINATION WITH OTHER AGENCIES

No other sureties cover this property.

113.3. SURETY AMOUNT

The amount of the surety is based on the cost required to reclaim five years of development of the West Pits and East Pit, as well as, the West Operation Facilities. The surety amount totals $780,432.96. Surety calculations are presented in Table 113-1 and Appendix 113-1.

113.4. SURETY TYPE

Sunroc will post a bond to cover the required reclamation costs as summarized in Table 113-1 and calculated in Appendix 113-1 after notification from the Division and prior to causing any site disturbances. The bond will be a corporate surety bond from a surety company that is licensed to do business in Utah. Furthermore, the surety company will be one that is listed in "A.M. Best's Key Rating Guide" at a rating of A- or better or will have a Financial Performance Rating (FPR) of 8 or better, according to the "A.M. Best's Guide". The surety company also will be continuously listed in the current issue of the U.S. Department of the Treasury Circular 570.

113.5. SURETY RELEASE

Following the completion of the required reclamation activities for each area of the mine property, Sunroc will monitor the reclaimed areas. As these reclaimed areas meet the criteria for adequate reclamation, Sunroc will petition the Division for release the surety for that portion of the operation.

113.6. SURETY ADJUSTMENTS AND REVISIONS

In accordance with existing DOGM Mining and Reclamation Regulations, the surety agreement will be reviewed every five years.

R647-4-114. FAILURE TO RECLAIM.

Sunroc understands that if it fails to conduct reclamation as outlined in this application, the Division may, at the order of the Board of Oil, Gas, and Mining, conduct the outlined reclamation. Further it understands that the cost and expenses of reclamation, covered by the surety posted by Sunroc, may be forfeit under this condition.

R647-4-115. CONFIDENTIAL INFORMATION.

No confidential information has been submitted as part of this application.

R647-4-116. PUBLIC NOTICE AND APPEALS.

Sunroc agrees to participate in the public notice and appeals process of the Mined Land Reclamation rules.

R647-4-117. NOTIFICATION OF SUSPENSION OR TERMINATION OF OPERATIONS.

117.1. SHORT-TERM SUSPENSION OF OPERATIONS

If for any reason Sunroc determines that operations at the Chicken Creek Mine should be discontinued for a period of more than 2 years, but not longer than 5 years, Sunroc will notify the Division of Oil Gas, and Mining. Upon request, Sunroc will provide the Division with such data and information necessary to evaluate the status of the mining operation, the status of compliance with the mining rules, and the probable future plans for the property.

117.2. LONG-TERM SUSPENSION OF OPERATIONS

If for any reason Sunroc determines that operations at the Chicken Creek Mine should be discontinued for a period of more than 5 years, Sunroc will notify the Division of Oil Gas, and Mining. Upon request, Sunroc will meet with the Division to conduct a site inspection to evaluate the status of the mining operation, the status of compliance with the mining rules, and the probable future plans for the property. Based on the future plans, Sunroc will allow regular inspection of the property by the Division to ensure continued compliance.

Sunroc understands that if the operation is suspended for a period of longer than ten years, the Division may require reclamation of the facility. Depending on future plans, Sunroc reserves the right to appeal to the Board for an extension to the suspension period.

R647-4-118. REVISIONS.

Any significant changes to the permit will be addressed through the revision process of the Mined Land Reclamation rules.

R647-4-119. AMENDMENTS.

For small or insignificant changes to the permit, Sunroc will work with Division personnel on a case-by-case basis to determine the best way to address the proposed change.

R647-4-120. TRANSFER OF NOTICE OF INTENTION.

In the event that Sunroc desires to transfer ownership of the mining operation to another entity, a Transfer of Notice of Intention form will be filed with the Division of Oil, Gas, and Mining.

R647-4-121. REPORTS.

On or before January 31st of each year, Sunroc will submit an Annual report of Mining Operations describing its operations during the preceding year. This report will contain the following:

- Amount of ore and waste materials generated and disposition of such material;
- Areas of reclamation performed during the year and any areas of new surface disturbance; and
- An updated map of surface disturbances.

Additionally, Sunroc will maintain complete records of mine operations and will make these records available to the Division upon request.

REFERENCES

Auby, William L. 1991. *Provisional Geologic Map of the Levan Quadrangle, Juab County, Utah*, Utah Geological Survey, Utah Department of Natural Resources.

Burden, C.B. and others, 2004: *Ground-Water Conditions in Utah, Spring of 2004*. Cooperative Investigation Report Number: 45. Utah Department of Natural Resources, Division of Water Resources. Salt Lake City, UT.

Haestad Methods, Inc. 1998. FlowMaster. Computer Program, Version 6.0 Waterbury, Connecticut.

HydroCAD. Software Solutions, LLC. 2005. HydroCAD Version 8.50. Chocorua, New Hampshire.

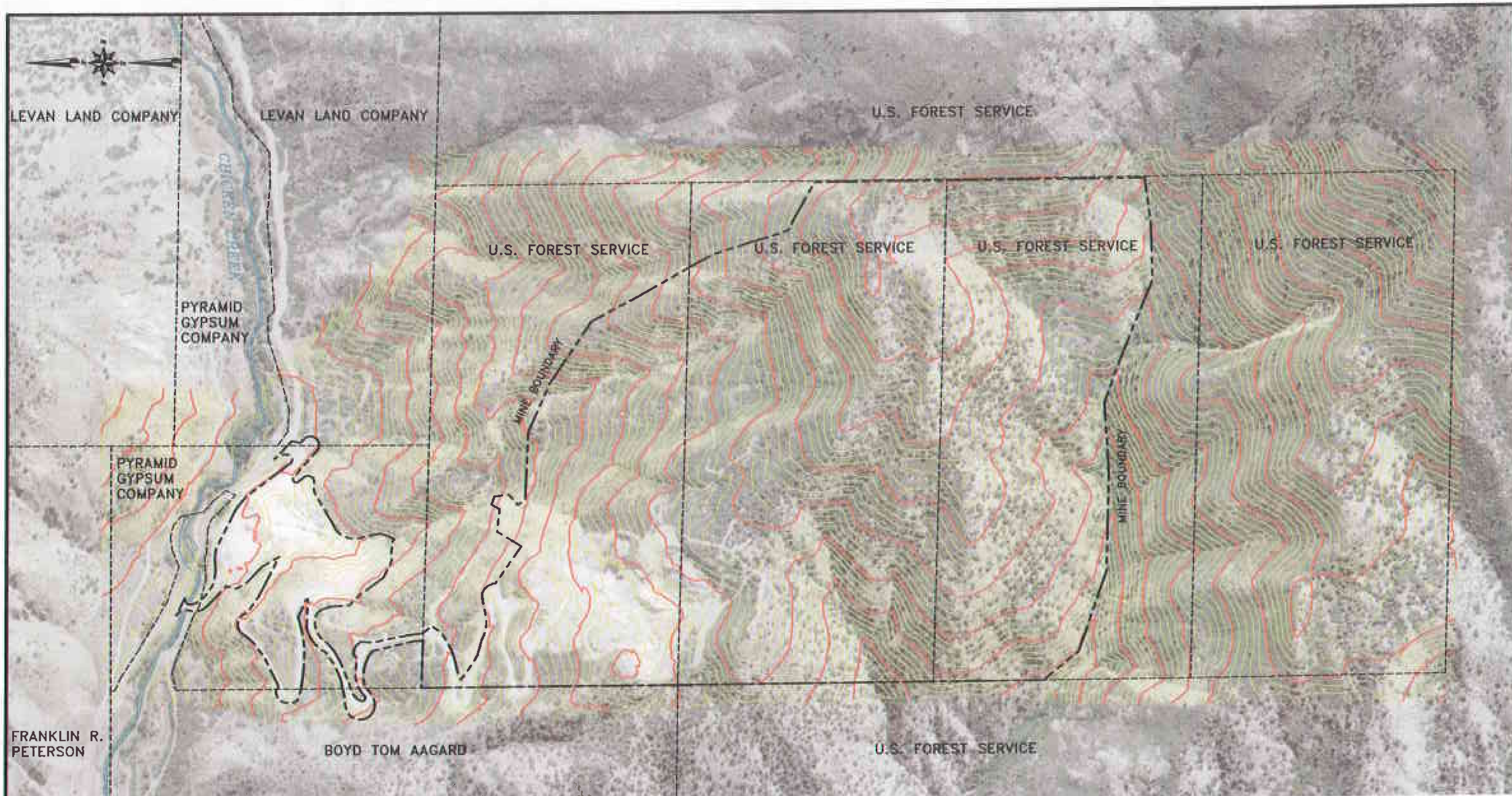
Hylland M. and Machette M. 2008. *Surficial Geologic Map of the Levan and Fayette Segments of the Wasatch Fault Zone, Juab and Sanpete Counties, Utah*. Utah Geological Survey Map 229.

Meinzer. O.E. 1911. *Ground water in Juab, Millard, and Iron Counties Utah*. USGS Water-Supply Paper: 277.

Utah Division of Water Quality, 2008. *Chicken Creek Assessment of Total Dissolved Solids.*

Worwood, Jason (City of Levan Utilities Manager). Telephone interview, 20 May 2009.

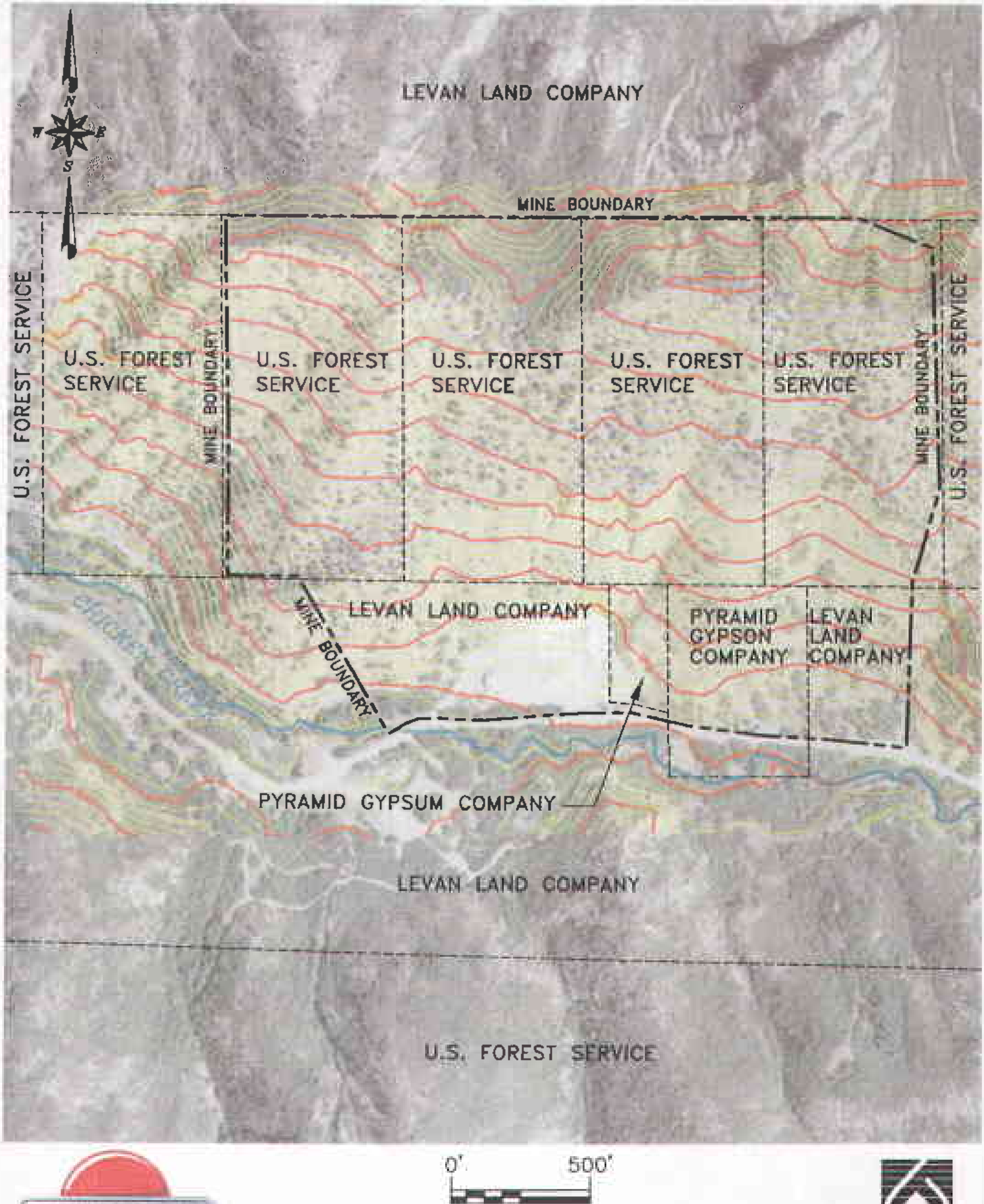
FIGURES



SUNROC

FIGURE 104–1A. WEST CHICKEN CREEK MINE LAND OWNERSHIP

EarthFax



SUNROC

FIGURE 104–1B. EAST CHICKEN CREEK MINE LAND OWNERSHIP

EarthFax

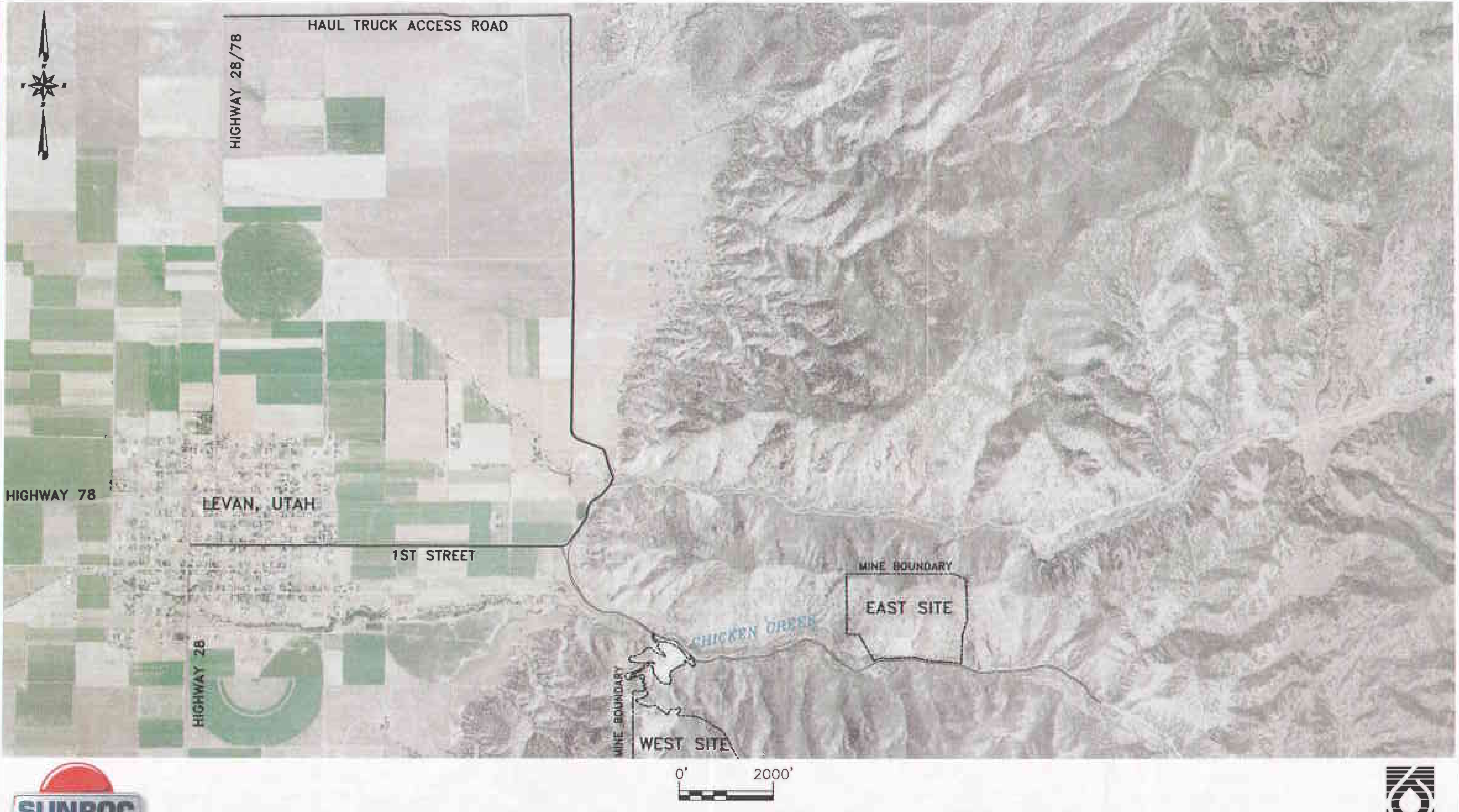
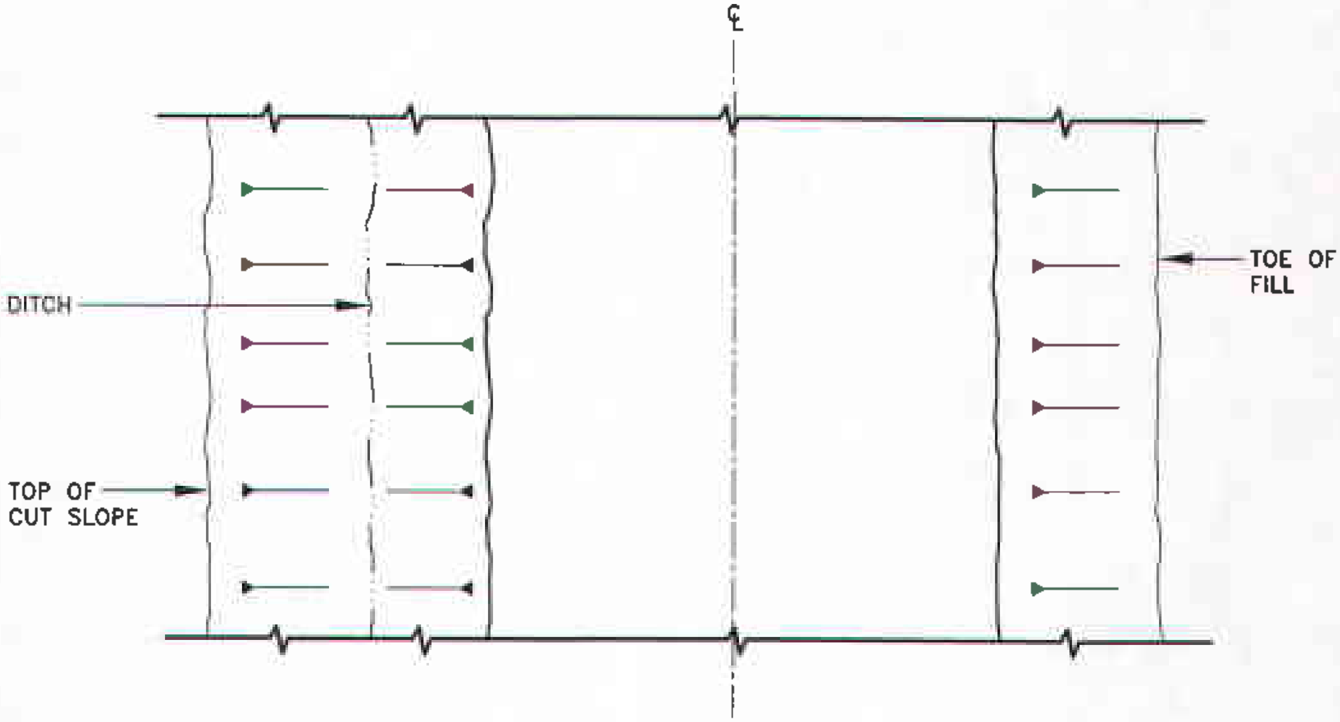
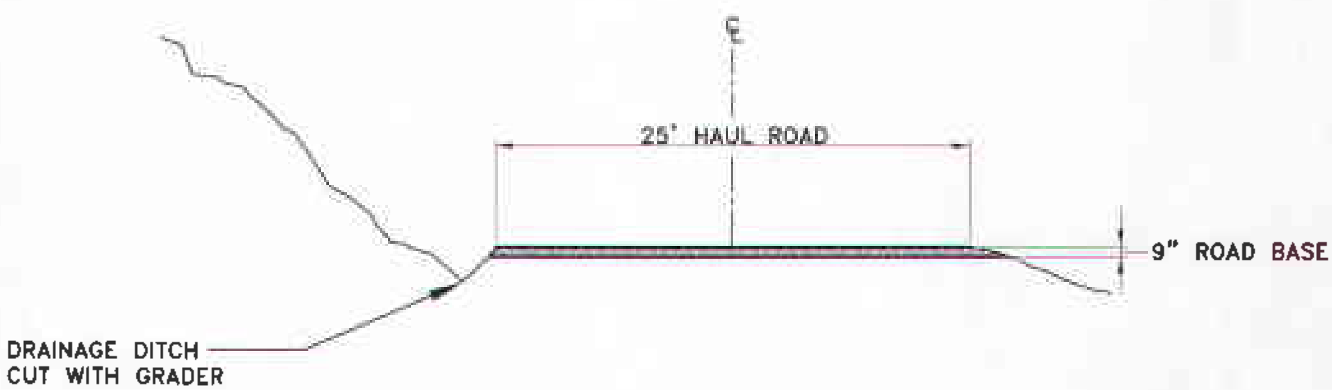


FIGURE 105–1. CHICKEN CREEK MINE LOCATION AND SITE ACCESS ROADS

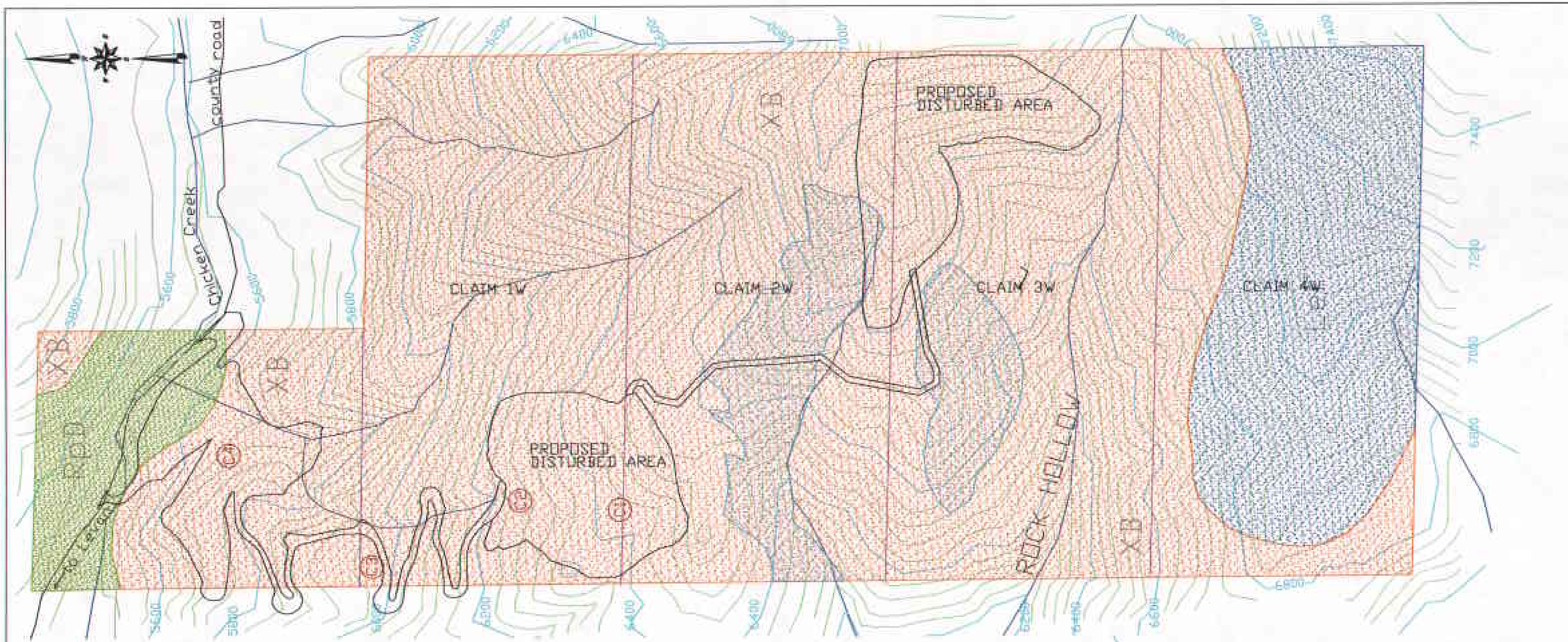


PLAN VIEW
NTS



ELEVATION VIEW
NTS

FIGURE 106-3. TYPICAL ROAD CROSS-SECTION



SOILS MAP
of
LEVAN CHICKEN CREEK

HE DAVIS CONSTRUCTION
SPANISH FORK, UTAH

Information Source:
Soil Survey of Fairview-Nephi Area, Utah, USDA, National Resources Conservation Service.

Chected By:
P. D. Collins, Ph.D
Date:
4/14/03

DRG. #
III - C W

C1 Soil Sample Locations

RpD-Rofis Gravelly Clay Loam, 4 to 15% Slopes.

XB-Xeric Torriorthents-Rock Outcrop Complex, Steep.

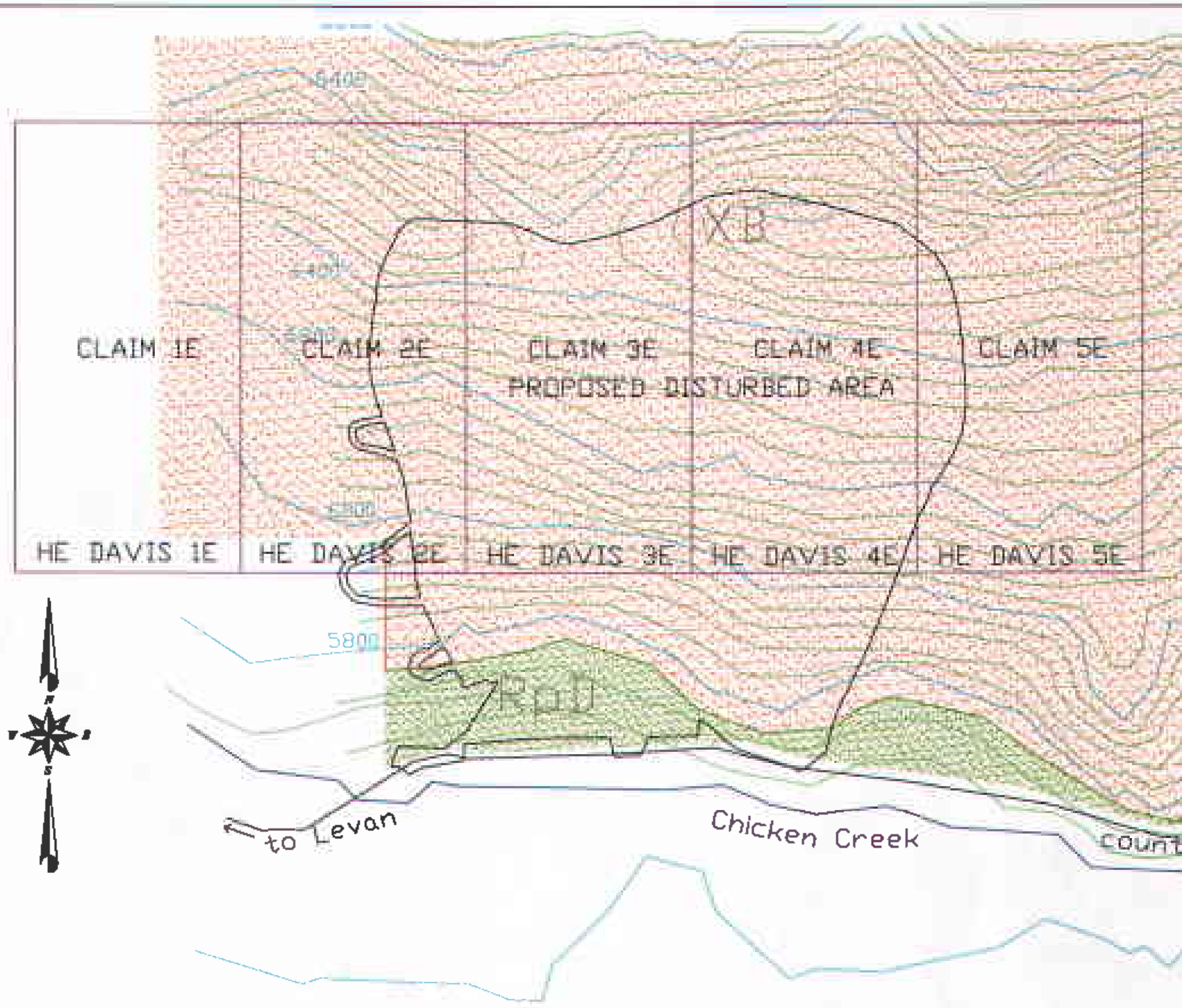
LeF-Lundy-Rock Outcrop Complex, 30 to 70% Slopes.

0' 500'

FIGURE 106-5A WEST MINE SOILS

SUNROC

EarthFax



BASE MAP of LEVAN CHICKEN CREEK

HE DAVIS CONSTRUCTION
SPANISH FORK, UTAH

contour interval - 40 feet

Drawn By: Tony Christofferson Date: 2/8/04	DRG. # II B-2 E

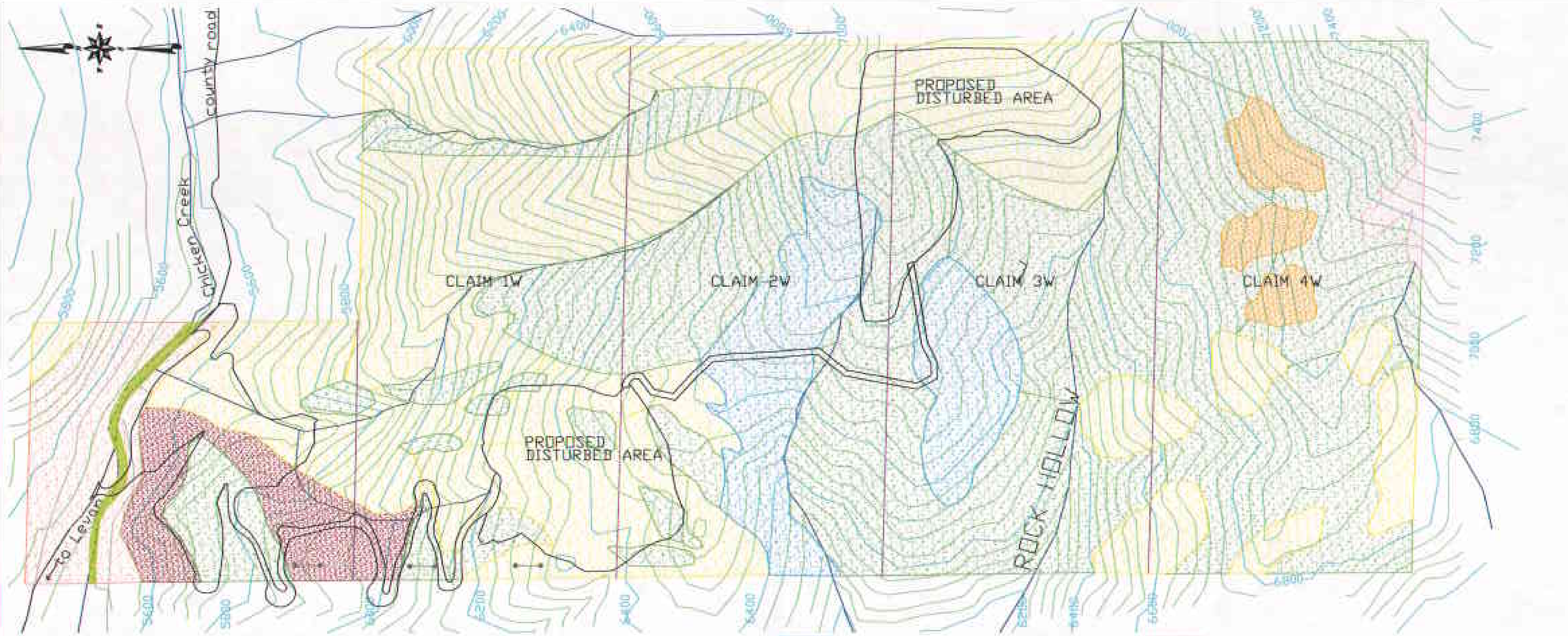
RpD- Rofis Gravelly Clay Loam, 4 to 15% Slopes.

XB- Xeric Torriorthents-Rock Outcrop Complex, Steep.

0' 500'

FIGURE 106-5B EAST MINE SOILS

EarthFax



VEGETATION MAP
of
LEVAN CHICKEN CREEK

HE DAVIS CONSTRUCTION
SPANISH FORK, UTAH

Vegetation

Date:	DRG. #
4/14/03	III - D W

Transect Line

Riparian

Sagebrush/Grass

Slender Wheatgrass /Mountain Mahogany

Pinyon-Juniper

Mountain Mahogany

Manzanita

Gambels' Oak

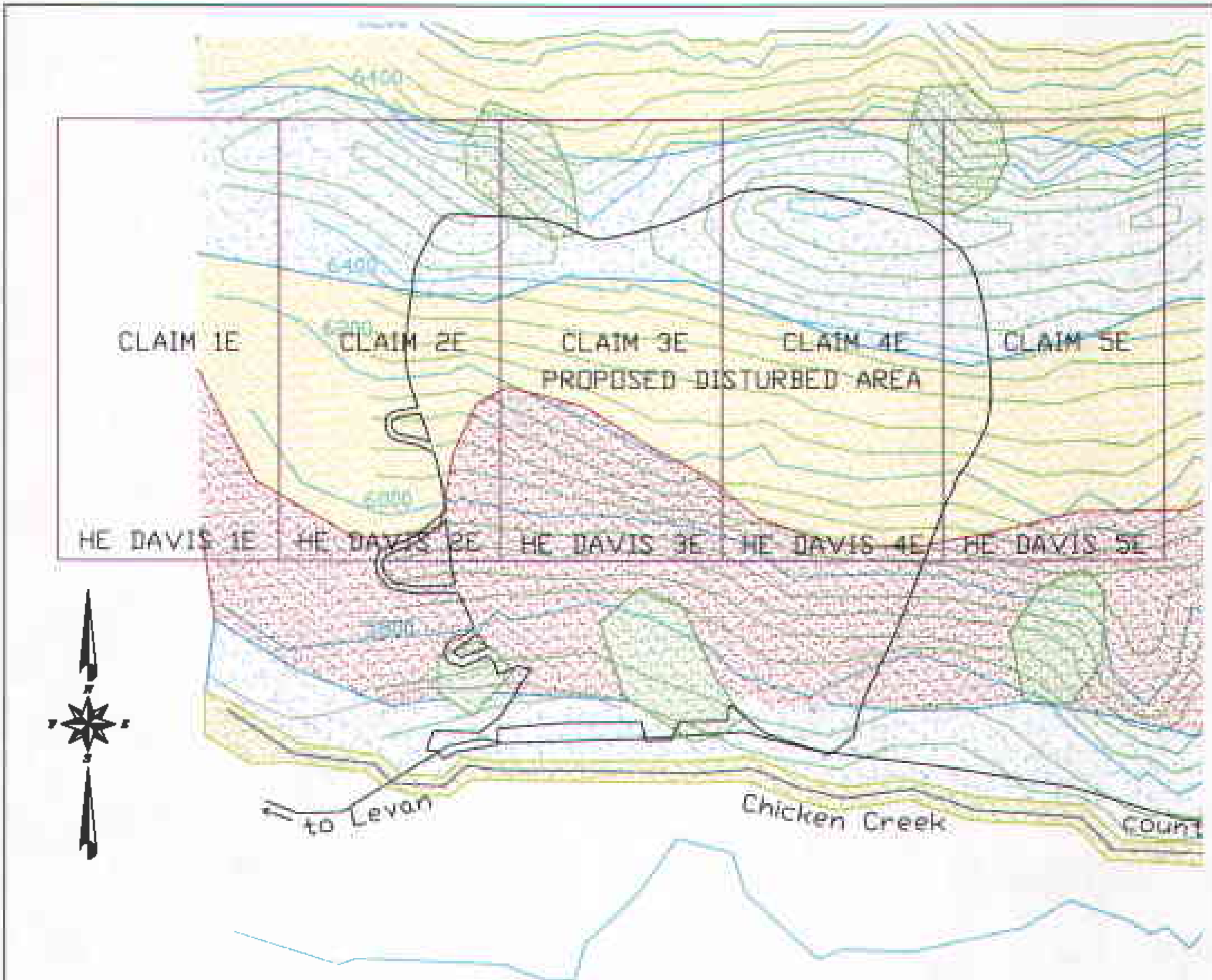
Conifer

0' 500'

SUNROC

FIGURE 106–7A WEST MINE VEGETATION

EarthFax



VEGETATION MAP
of
LEVAN CHICKEN CREEK

HE DAVIS CONSTRUCTION
SPANISH FORK, UTAH

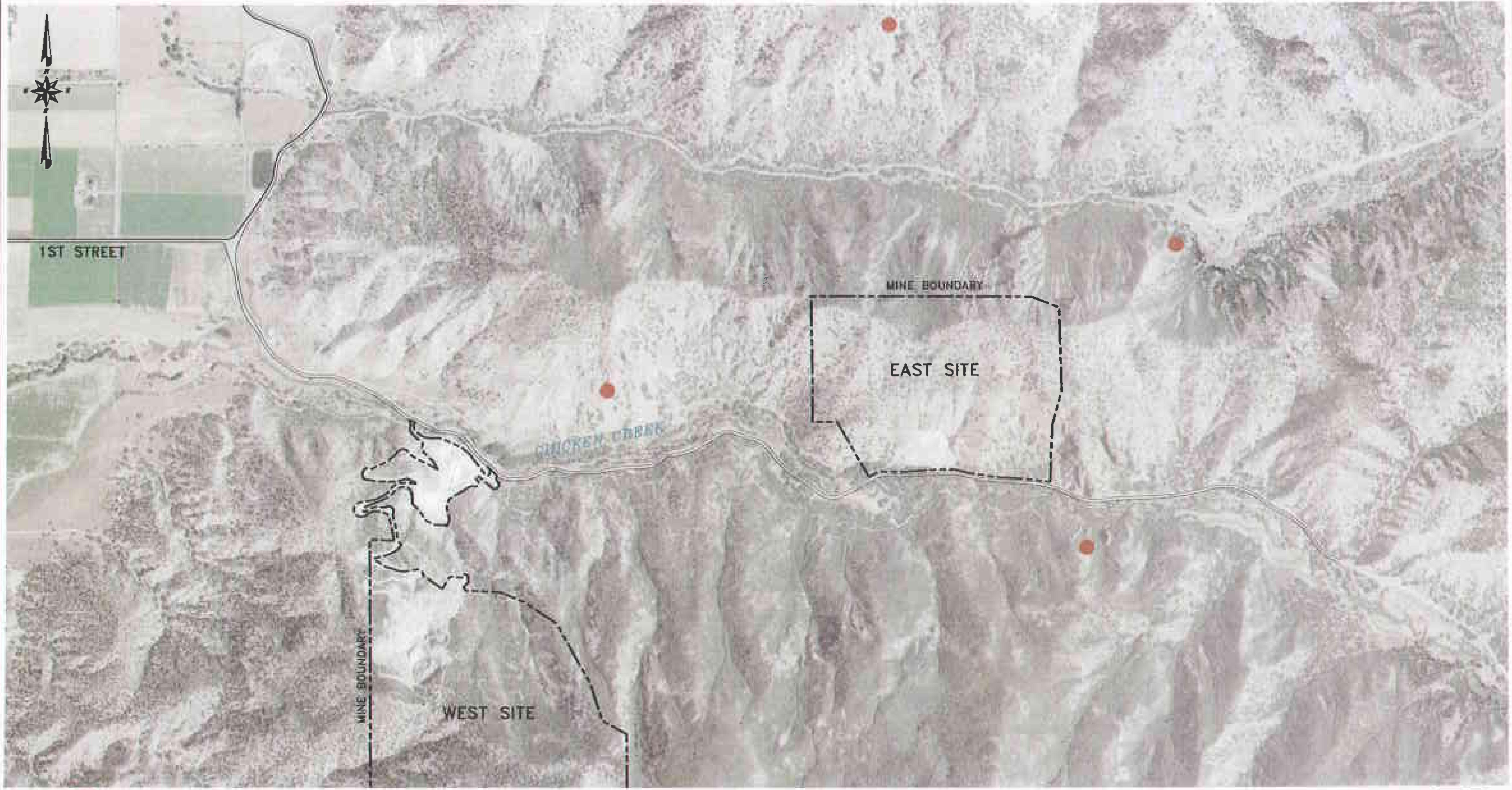
Vegetation	DRG. # III - D E

- Slender Wheatgrass /Mountain Mahogany
- Pinyon-Juniper
- Mountain Mahogany
- Gambels' Oak
- Riparian

0' 500'

FIGURE 106-7B EAST MINE VEGETATION

EarthFax



LEGEND

GOLDEN EAGLE NESTS

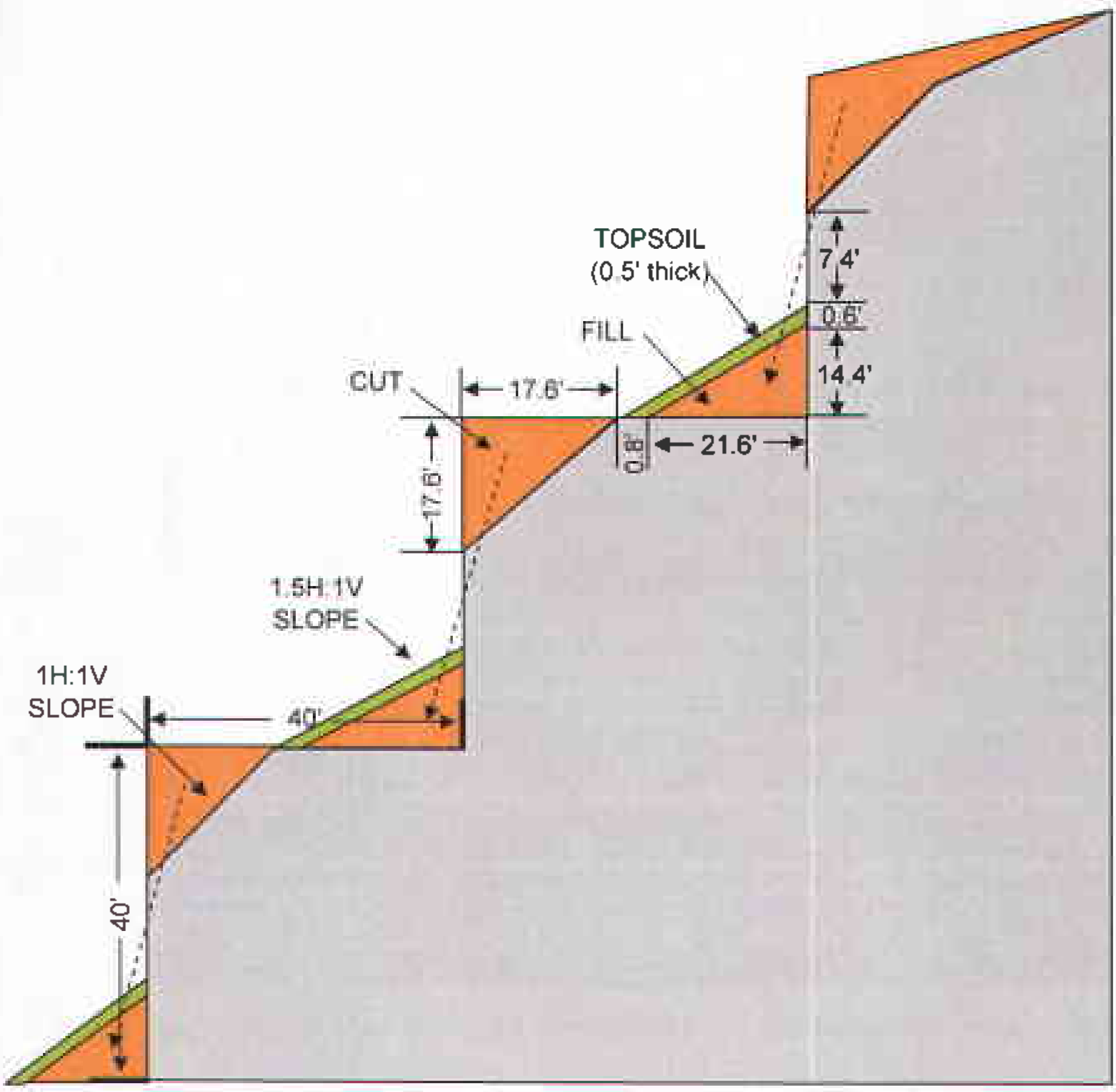
0' 1000'

FIGURE 109–2. GOLDEN EAGLE NEST LOCATION

SUNROC

EarthFax

Figure 110-1
Typical Reclaimed Slope Cut and Fill Cross Section
Chicken Creek Mine
Sunroc Corporation



TABLES

TABLE 106-1
DISTURBED ACREAGE SUMMARY
SUNROC CORPORATION
CHICKEN CREEK MINE

Area Name	No. Acres
Life of Mine Disturbance Limit	285.5
East Pit (including Op. Facility and Roadways)	53.5
West Op. Facility (including Roadway to Lower West Pit)	15.9
Lower West Pit	16.6
Upper West Pit Roadway	1.6
Upper West Pit	17.8
TOTAL DISTURBED AREA	**105.4**

Notes:
The Upper West Pit is not scheduled for construction until the Lower West Pit is completed (at least 2030)
The Life of Mine Disturbance Limit includes both the Upper and Lower West Pits and East Pit as well as an additional buffer area to accommodate rockfall and/or flyrock.

TABLE 107-1
GENERAL SCHEDULE OF ANTICIPATED MINE OPERATIONS
SUNROC CORPORATION
CHICKEN CREEK MINE

Action	Timing
EAST PIT	
Construct access road improvements	~ 1 week
Construct runoff control berm on pit floor	~2 days
Construct sedimentation pond, South Pit	~ 2 weeks
Clearing and Grubbing	Ongoing, as needed
Construct berms, install silt fencing	Ongoing, as needed
Stockpile topsoil	Ongoing, as needed
Drill/blast/load/haul	~ 1 year
Improving sedimentation pond, South Pit	~ 2 weeks
Clearing and Grubbing	Ongoing, as needed
Construct berms, install silt fencing	Ongoing, as needed
Stockpile topsoil	Ongoing, as needed
Complete East Pit	*Approx 100 yrs. after start of ops.
LOWER WEST PIT	
Construct runoff control berm on pit floor	~2 days
Construct sedimentation pond, Lower West Pit	~ 2 weeks
Clearing and Grubbing	Ongoing, as needed
Construct berms, install silt fencing	Ongoing, as needed
Stockpile topsoil	Ongoing, as needed
Drill/blast/load/haul	Ongoing, as needed
Complete Lower West Pit	*Approx 20 yrs.
Reclaim Site	~ 1 month
LOWER WEST PIT	
Construct runoff control berm on pit floor	~2 days
Construct sedimentation pond, Upper West Pit	~ 2 weeks
Extending access road for Upper West Pit	`1 month
Clearing and Grubbing	Ongoing, as needed
Construct berms, install silt fencing	Ongoing, as needed
Stockpile topsoil	Ongoing, as needed
Drill/blast/load/haul	Ongoing, as needed
Complete Upper West Pit	*Approx 100 yrs. after start of ops.
Reclaim Site	~ 1 month

Notes:
Initiation date of operations is unknown.
Runoff and sedimentation control structures will be constructed prior to all disturbances.
Disturbance will be minimized for each phase of operations
Upper and Lower West Pit Ponds and Channels for controlling runoff will be adjusted and moved as needed.

*At current rate of extraction. Extraction rate may inrease in the future, however this is not anticipated at this time.

Table 107-3
Erosion Volume Calculations for Pond Watersheds
Chicken Creek Mine
Sunroc Corporation

Upper West Pit Pond

Area No.		Area	Area (ac)	Upper Elevtion (ft)	Lower Elevation (ft)	LS length (ft)	LS	R	K	VM	A (t/ac/yr)	Soil Density (pcf)	Annual Sediment Volume (ft^3)
West Pond #1	DWS #1	772,505	17.73	7160	6780	880.00	0.43	7	0.4	0.90	1.09	110	350.87
West Pond #1	DWS #2	197,851	4.54	6930	6780	430.00	0.35	7	0.4	0.90	0.88	110	72.60
	TOTAL	772,505	17.73										**423**

Lower West Pit Pond

Area No.		Area	Area (ac)	Upper Elevtion (ft)	Lower Elevation (ft)	LS length (ft)	LS	R	K	VM	A (t/ac/yr)	Soil Density (pcf)	Annual Sediment Volume (ft^3)
West Pond #2	DWS	780,592	17.92	6590	6320	847.00	0.32	7	0.4	0.90	0.80	110	261.73
	TOTAL	780,592	17.92										**262**

A = R K LS VM

Annual Sediment Volume = A X Area / Soil Density

Notes (for all Sheets)

Erosion calculation method taken from Isrealson et al, 1984

R is taken from isoerodent map of Utah as 7.

K is taken from Soils of Utah Soil Erodibility Index Map to be between 0.11 and 0.20. For this site the greater value of 0.20 was used due to poor nature of soil.

VM values are taken from Table 3 (Isrealson et al, 1984) as follows: 0.35 for undisturbed areas (brush), 1.20 for regraded slopes (compacted dozer scraped across slope), 0.90 for disturbed benches (rough irregular tracked all directions), and 0.66 for rocky bench faces (undisturbed except scraped). Due to irregularities in disturbed slope areas an average of 0.9 was used for all disturbed areas.

Soil density assumed to be 110 pcf.

Lower West Pit Pond

Area No.		Area	Area (ac)	Upper Elevtion (ft)	Lower Elevation (ft)	LS length (ft)	LS	R	K	VM	A (t/ac/yr)	Soil Density (pcf)	Annual Sediment Volume (ft^3)
West Pond #3	DWS #1	20,227	0.46	6260	6180	517.00	0.15	7	0.4	0.90	0.39	110	3.29
West Pond #3	DWS #2	22,759	0.52	6180	6125	609.00	0.09	7	0.4	0.90	0.23	110	2.16
West Pond #3	DWS #3	21053	0.48	6125	6060	493.00	0.13	7	0.4	0.90	0.33	110	2.92
West Pond #3	DWS #4	24442	0.56	6060	5985	493.00	0.15	7	0.4	0.90	0.38	110	3.91
West Pond #3	DWS #5	30284	0.70	5985	5880	694.00	0.15	7	0.4	0.90	0.38	110	4.82
West Pond #3	DWS #6	63978	1.47	5880	5790	862.00	0.10	7	0.4	0.90	0.26	110	7.03
West Pond #3	UWS #1	8107	0.19	5840	5734	298.00	0.36	7	0.4	0.35	0.35	110	1.18
West Pond #3	UWS #2	130833	3.00	6410	6185	467.00	0.48	7	0.4	0.35	0.47	110	25.78
West Pond #3	UWS #3	96685	2.22	6260	6125	354.00	0.38	7	0.4	0.35	0.37	110	15.08
West Pond #3	UWS #4	80594	1.85	6220	6125	322.00	0.30	7	0.4	0.35	0.29	110	9.73
West Pond #3	UWS #5	66019	1.52	6120	5985	337.00	0.40	7	0.4	0.35	0.39	110	10.82
West Pond #3	UWS #6	171049	3.93	6080	5880	489.00	0.41	7	0.4	0.35	0.40	110	28.62
West Pond #3	UWS #7	218788	5.02	6050	5790	585.00	0.44	7	0.4	0.35	0.44	110	39.78
	TOTAL	954,818	21.92										**155**

Lower West Pit Pond

Area No.		Area	Area (ac)	Upper Elevtion (ft)	Lower Elevation (ft)	LS length (ft)	LS	R	K	VM	A (t/ac/yr)	Soil Density (pcf)	Annual Sediment Volume (ft^3)
West Pond #4	DWS #1	18,500	0.42	5790	5770	493.00	0.04	7	0.4	0.90	0.10	110	0.79
West Pond #4	DWS #2	17,046	0.39	5770	5710	443.00	0.14	7	0.4	0.90	0.34	110	2.43
West Pond #4	DWS #3	16892	0.39	5710	5670	443.00	0.09	7	0.4	0.90	0.23	110	1.60
West Pond #4	DWS #4	136548	3.13	5650	5598	394.00	0.13	7	0.4	0.90	0.33	110	18.96
West Pond #4	UWS #1	93093	2.14	5920	5770	407.00	0.37	7	0.4	0.35	0.36	110	14.03
West Pond #4	UWS #2	57511	1.32	5785	5710	234.00	0.32	7	0.4	0.35	0.31	110	7.54
West Pond #4	UWS #3	60719	1.39	5790	5670	182.00	0.66	7	0.4	0.35	0.65	110	16.38
	TOTAL	400,309	9.19										**62**

Lower West Pit Pond

Area No.		Area	Area (ac)	Upper Elevtion (ft)	Lower Elevation (ft)	LS length (ft)	LS	R	K	VM	A (t/ac/yr)	Soil Density (pcf)	Annual Sediment Volume (ft^3)
West Pond #5	DWS	141,148	3.24	5760	5660	260.00	0.38	7	0.4	0.90	0.97	110	57.10
West Pond #5	UWS #1	39,067	0.90	5820	5665	285.00	0.54	7	0.4	0.35	0.53	110	8.69
West Pond #5	UWS #2	156941	3.60	5960	5605	710.00	0.50	7	0.4	0.35	0.49	110	32.10
	TOTAL	337,156	7.74										**98**

East Pit Pond

Area No.		Area	Area (ac)	Upper Elevtion (ft)	Lower Elevation (ft)	LS length (ft)	LS	R	K	VM	A (t/ac/yr)	Soil Density (pcf)	Annual Sediment Volume (ft^3)
East Pond #1	DWS	643,895	14.78	6530	5675	1680.00	0.51	7	0.4	0.90	1.28	110	344.68
	TOTAL	643,895	14.78										**345**

East Pit Pond

Area No.		Area	Area (ac)	Upper Elevtion (ft)	Lower Elevation (ft)	LS length (ft)	LS	R	K	VM	A (t/ac/yr)	Soil Density (pcf)	Annual Sediment Volume (ft^3)
East Pond #2	DWS	1,614,910	37.07	6580	5720	1490.00	0.58	7	0.4	0.90	1.45	110	980.42
	TOTAL	1,614,910	37.07										**980**

TABLE 110-1
SEED MIX AND APPLICATION RATES
SUNROC COMPANY
CHICKEN CREEK MINE

Seed Type	Application Rate (lbs of pure live seed/acre)
Utah serviceberry-utahensis	1.500
Wyoming sagebrush-Tridentata Wyoming	0.750
Birch-leaf mountain mahogany-Montanus	3.750
Brubber rabbitbrush-nauseosus	0.225
White yarrow-millefolium	0.075
Blue flax-lewisii	0.750
Northern sweetvetch-Boreale	2.250
Firecracker penstemon-eatonii	0.375
Palmer penstemon-palmeri	0.375
Thickspike wheatgrass-lanceolatus	1.500
Slender wheatgrasstrachycaulus	2.250
Ryegrass-smithii	1.500
Ryegrass-spicatus	2.250
Needlegrass-hymenoides	1.500
Total	19.050

TABLE 113-1
SURETY ESTIMATE SUMMARY
SUNROC CORPORATION
CHICKEN CREEK MINE

DIRECT COSTS			
RSMEANS ITEMS			
CLEANUP, REMOVAL, DEMOLITION/BURIAL OF FACILITIES/STRUCTURES			
REMOVAL/DISPOSAL OF HAZARDOUS MATERIALS			
BACKFILLING, GRADING, AND CONTOURING			$ 456,368.55
SOIL MATERIAL REDISTRIBUTION AND STABILIZATION			$ 13,662.84
RIPPING PIT FLOORS, ACCESS ROADS, SLOPES			$ 50,739.33
DRAINAGE RECONSTRUCTION			$ 27,687.25
MULCHING/REVEGETATION			$ 85,381.50
		SUBTOTAL RSMEANS ITEMS	$ 633,839.47
DR (77.6%)		CITY COST INDEX (77.6%)	$ (141,980.04)
ITEMS ESTIMATED WITHOUT USING RS MEANS			
GENERAL SITE CLEANUP			$ 2,000.00
		SUBTOTAL NON-RSMEANS ITEMS	$ 2,000.00
		TOTAL DIRECT COSTS	$ 493,859.43
INDIRECT COSTS			
MOB/DEMOB (5%)			$24,692.97
CONTINGENCIES (10%)			$49,385.94
CONTRACTOR OVERHEAD AND PROFIT (10%)			$49,385.94
RECLAMATION MANAGEMENT FEE (10%)			$49,385.94
		TOTAL INDIRECT COSTS	$172,850.80
		SUBTOTAL RECLAMATION COST	$666,710.23
ESCALATION (3.20%) OVER 5 YEARS			$113,722.73
		TOTAL RECLAMATION COST	**$780,432.96**

Note: Location Factor taken from RSMeans Site Work and Landscape Cost Data 2008 for Price, UT
Bond estimate only for East and Lower West Pit. Upper West Pit will not be constructed until at least 2030
Refer to Appendix 113-1 for a detailed surety tabulation

PLATES

This page is a reference page used to track documents internally for the Division of Oil, Gas and Mining

Mine Permit Number M/023/0016 Mine Name CHICKEN CREEK MINE
Operator SUNROC CORPORATION Date Rec'd 5-26-09
TO OGM - WHW FROM Richard White

__CONFIDENTIAL __BOND CLOSURE X LARGE MAPS __EXPANDABLE
MULTIPUL DOCUMENT TRACKING SHEET __NEW APPROVED NOI
__AMENDMENT _OTHER______________________

Description YEAR-Record Number

__NOI X Incoming __Outgoing __Internal __Superceded

105-1A WEST SITE BOUNDARY CONDITIONS 2006
105-1B EAST SITE BOUNDARY CONDITIONS 2006
105-2A PROPOSED WEST SITE BASE AND MINING CONDITIONS
105-2B PROPOSED EAST SITE BASE AND MINING CONDITIONS

__NOI X Incoming __Outgoing __Internal __Superceded

106-1A PROPOSED WEST SITE BASE AND DRAINAGE BOUNDARY
106-1B PROPOSED EAST SITE BASE AND DRAINAGE BOUNDARY
106-1C PROPOSED POND DETAILS
110-1A WEST SITE RECLAMATION CONDITIONS

__NOI X Incoming __Outgoing __Internal __Superceded

110-1B EAST SITE RECLAMATION CONDITIONS

__NOI __Incoming __Outgoing __Internal __Superceded

__TEXT/ 81/2 X 11 MAP PAGES __11 X 17 MAPS __LARGE MAP

COMMENTS: ______________________

CC: ______________________

APPENDIX 104-1

MINING CLAIM AND

LAND OWNERSHIP DOCUMENTATION

APPENDIX 106-1
SOIL DESCRIPTIONS AND SOIL LETTER FROM MT. NEBO SCIENTIFIC, INC.

SOIL RESOURCES
OF THE
LEVAN GYPSUM MINE

Prepared by

MT. NEBO SCIENTIFIC, INC.
330 East 400 South, Suite 6
P.O. Box 337
Springville, Utah 84663
(801) 489-6937

Patrick Collins, Ph.D.

for

GENEVA ROCK PRODUCTS
1565 West 400 North
Orem, Utah 84057

August 8, 2000

TABLE OF CONTENTS

SOIL RESOURCES
OF THE
LEVAN GYPSUM MINE

INTRODUCTION

General Site Description

Geneva Rock has an active gypsum mine in Juab County, Utah. The gypsum mine is located approximately 2 miles east of the town of Levan. This area is on the west slope of the San Pitch Mountains also known as the Gunnison Plateau. Elevation of the study site ranged from approximately 5,500 ft to nearly 7,500 ft above sea level.

Existing plant communities of the study site were comprised of mountain brush and other associated tree and shrub communities. These communities are described in greater detail in the section called "Vegetation of the Levan Gypsum Mine" of this report. Aside from one area that has been proposed for future disturbance in about 5 years, most of the disturbance to the resident soils have already been effected by mining activities.

The following soils types were located within the permit area of the Levan Gypsum Mine according to the Natural Resources Conservation Service (NRCS):

XB-Xeric Torriorthents-Rock outcrop complex, steep
LeF-Lundy-Rock outcrop complex, 30 to 70 percent slopes
RpD-Rofiss gravelly clay loam, 4 to 15 percent slopes.

Color photographs have been included in this report that show the native soils and the plant communities that grow on them. The disturbed soils are also shown in one of the photographs.

METHODS

Field work was conducted at the site in July and August 2000 to confirm some of the information about the soils in the area as described by the NRCS. Although composite sampling was done on the disturbed soils of the mine site, no soil pits were dug in the native, undisturbed soils in the area. The soil descriptions below were taken directly from the Soil Survey of Fairfield-Nephi Area, Utah [USDA, Soil Conservation Service (1984)]. A map showing the location of each soil type is shown on the soils map included in this report.

Soil sampling was conducted on the disturbed "soil" material that remains following mining activities. Composite samples were made in specific locations throughout current mine area. At these locations ten (10) subsamples were taken and mixed together to form one composite sample (e.g. C1 = ten subsamples from a specific area mixed together). The lab results should provide important information in preparation of the reclamation and revegetation plan. Sample locations are shown on the Soil Resource map included in this report.

RESULTS

XB-Xeric Torriorthents-Rock outcrop complex, steep

This map unit is on hillsides. Slopes are 30 to 70 percent and are medium in length and convex. In most areas the present vegetation is mainly a sparse cover of shrubs. Elevation is 5,600 to 7,600 feet. The average annual precipitation is 12 to 16 inches, the mean annual air temperature is 45 to 52 degrees F, and the average freeze-free season is 100 to 140 days.

This unit is about 60 percent Xeric Torriorthents, 30 to 70 percent slopes, and 20 percent Rock outcrop. The Xeric Torriorthents is on side slopes, and the Rock outcrop is on ridges and escarpments. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 10 percent Rofiss gravelly clay loam, 4 to 15 percent slopes, and 5 percent Manila loam, 8 to 15 percent slopes, on alluvial fans, and 5 percent Lizzant very cobbly loam, dry, 30 to 60 percent slopes, on hillsides. The percentage of these included soils varies from one area to another.

The Xeric Torriorthents are shallow to moderately deep and well drained. They formed in residuum and colluvium derived dominantly from shale. These soils are variable but commonly the surface layer is shaly and very shaly loam to clay loam about 3 inches thick. The underlying material is shaly and very shaly clay loam to silty clay about 4 to 37 inches thick. Bedrock is at a depth of 7 to 40 inches. Depth to bedrock ranges from 10 to 40 inches.

Permeability of the Xeric Torriorthents is slow or very slow. Available water capacity is about 1 inch to 2 inches. Water supplying capacity is 2 to 5 inches. Effective rooting depth is 10 to 40 inches. The organic matter content of the surface layer is 0 to 2 percent. Runoff is rapid, and the hazard of water erosion is high.

Rock outcrop consists of exposures of barren shale, mainly on escarpments and ridges. This unit is used for wildlife habitat. The potential plant community on this soil is about 20 percent perennial grasses, 10 percent forbs, and 70 percent shrubs. Important plant species are birchleaf mountain mahogany, bluebunch wheatgrass, and Sandberg bluegrass. Because the soil is steep and shallow, grazing management practices are poorly suited to this unit.

This unit is poorly suited to recreation and homesite development. The main limitations are the steepness of slope and the shallow depth of the soil to bedrock. This map unit is in capability unit VIIs-U3, nonirrigated.

<u>LeF-Lundy-Rock outcrop complex, 30 to 70 percent slopes</u>

This map unit is on mountainsides and hillsides. Slopes are long and convex. In most areas the present vegetation is mainly grasses and shrubs. Elevation is 5,600 to 8,100 feet. The average annual precipitation is 14 to 18 inches, the mean annual air temperature is 41 to 45 degrees F, and the average freeze-f ree season is 70 to 110 days.

This unit is about 60 percent Lundy very cobbly loam, 30 to 70 percent slopes, and 20 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 5 percent Atepic shaly loam, 10 to 40 percent slopes; 5 percent Lizzant very cobbly loam, 8 to 30 percent slopes; and 5 percent Lodar very cobbly loam, 30 to 70 percent slopes, on hillsides. Borvant cobbly loam, 8 to 25 percent slopes, on alluvial fans, also makes up five percent of this unit. The percentage of these included soils varies from one area to another. The Lundy soil is shallow and somewhat excessively drained. It formed in colluvium and residuum derived dominantly from limestone and sandstone. Typically, the surface layer is dark brown very cobbly loam about 6 inches thick. The underlying material is pale brown and brown very cobbly loam about 13 inches thick.

Limestone is at a depth of 19 inches. Depth to limestone ranges from 10 to 20 inches. Permeability of the Lundy soil is moderate. Available water capacity is about I inch to 2 inches. Water supplying capacity is 2 to 4 inches. Effective rooting depth is 10 to 20 inches. The organic matter content of the surface layer is 1 to 3 percent. Runoff is medium, and the hazard of water erosion is slight.

Rock outcrop consists of exposures of barren bedrock, mainly on escarpments and ridges. This unit is used as rangeland and for wildlife habitat. The potential plant community on the Lundy soil is about 65 percent perennial grasses, 3 percent forbs, 7 percent shrubs, and 25 percent trees. Important plant species are bluebunch wheatgrass, Utah juniper, Indian ricegrass, and black sagebrush. The normal expected yield of total air-dried herbage is about 1,500 pounds per acre. Because of the steepness of slopes and shallow depth to bedrock, grazing management practices are poorly suited to this unit.

This unit is poorly suited to recreational uses and homesite development. The main limitations are slope, stoniness, shallow depth to bedrock, and Rock outcrop. This map unit is in capability unit VIls-U3J, nonirrigated. The range site is Upland Shallow Loam (Juniper).

RpD-Rofiss gravelly clay loam, 4 to 15 percent slopes.

This very deep, well drained soil is on alluvial fans. It formed in alluvium derived dominantly from shale. Slopes are medium in length and are convex. In most areas the present vegetation is mainly grasses and shrubs. Elevation is 5,100 to 5,500 feet. The average annual precipitation is about 12 to 14 inches, the mean annual air temperature is 45 to 52 degrees F, and the freeze-free season is 100 to 140 days.

Typically, the surface layer is pale brown gravelly clay loam about 12 inches thick. Below this to a depth of 60 inches or more is light gray very gravelly clay loam to extremely gravelly clay loam.

Included in this unit are about 5 percent Donnardo stony loam, 2 to 8 percent slopes, on alluvial fans, and 5 percent Xeric Torriorthents, 30 to 70 percent slopes, on hillsides. The percentage of these included soils varies from one area to another.
Permeability of this Rofiss soil is moderately slow. Available water capacity is 3.5 to 7 inches. Water supplying capacity is 6.5 to 8 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is I to 2 percent. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and for wildlife habitat and irrigated pasture. The potential plant community on this soil is about 65 percent perennial grasses, 15 percent forbs, and 20 percent shrubs. Important plant species are bluebunch wheatgrass, Wyoming big sagebrush, muttongrass, needle-and-thread, Nevada bluegrass, and antelope bitterbrush. The normal expected yield of total air-dried herbage is about 975 pounds per acre.

Management practices needed to maintain or improve the vegetation include proper grazing use, proper seasonal use, good water distribution, and a planned grazing system. Dense stands of big sagebrush may develop as a result of continuous overgrazing. Brush management by prescribed burning or chemical or mechanical treatment and proper grazing use can improve deteriorated rangeland. Where brush is managed by these methods, however, the soil may be subject to a higher hazard of erosion.

This unit is suited to range seeding. Plants suitable for seeding include Whitmar wheatgrass, slender wheatgrass, antelope bitterbrush, and species of the potential plant community for which seed or stock is available.

If this unit is used for hay and pasture, the main limitations are the high content of gravel and the strong alkalinity of the soil. If this unit is used for recreation or homesite development, the main limitations are small stones and slope. Erosion is a hazard in the steeper areas. Only the part of the site that is used for construction should be disturbed. In summer, irrigation is required for lawns, shrubs, vines, shade trees, and ornamental trees.

This unit is in capability units IVs-24, irrigated, and Vls- U4, nonirrigated. The range site is Upland Stony Loam.

Laboratory Results

The following Table 1 shows the laboratory results from sampling the disturbed "soil" material, or that material that is left behind for reclamation following mining activities.

TABLE 1: Laboratory results from disturbed "soils" at the Levan Gypsum Mine				
	SAMPLE NO. *			
PARAMETERS	**C1**	**C2**	**C3**	**C4**
Nitrate-Nitrogen (ppm N)	110.53	26.54	13.32	7.68
Phosphorus (ppm P)	0.34	0.52	4.35	3.13
Potassium (ppm K)	44.80	44.80	105.60	92.80
Salinity-ECe (mmhos/cm)	2.70	2.35	3.40	2.50
Calcium (ppm Ca)	1008.00	896.80	1278.00	807.50
Magnesium (ppm Na)	53.77	67.00	259.30	190.20
Sodium (ppm Na)	86.26	67.39	60.61	32.47
Sodium Adsorption Ratio (SAR)	0.72	0.58	0.40	0.27
Total Nitrogen (ppm Tot. N)	348.21	852.77	909.62	341.11
Calcium Carbonate (% $CaCO_3$)	25.67	41.83	52.74	60.62
Percent Gravel (%)	36.77	33.90	50.68	48.60
Percent Moisture Saturation (%)	55.31	51.35	49.87	42.07
pH	7.36	7.38	7.41	7.69
Sand (%)	47.00	47.92	42.56	42.92
Silt (%)	24.72	25.44	21.52	24.80
Clay (%)	28.28	26.64	35.92	32.28
Texture	Sandy Clay Loam	Sandy Clay Loam	Clay Loam	Clay Loam
Organic Matter (%)	0.72	1.69	2.66	0.92

* Each sample is a "composite"made by taking ten (10) subsamples and mixing them together to make one (1) sample.

COLOR PHOTOGRAPHS


General Mine Area Soil Types (also shows disturbed areas)


Mine Area Soil Types (foreground)

APPENDIX 106-2

BASELINE VEGETATION SURVEYS

LETTER FROM

MT. NEBO SCIENTIFIC, INC.

VEGETATION & WILDLIFE
OF THE
LEVAN GYPSUM MINE

Prepared by

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for

GENEVA ROCK PRODUCTS
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August 9, 2000

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VEGETATION & WILDLIFE
OF THE
LEVAN GYPSUM MINE

INTRODUCTION

General Site Description

Geneva Rock has an active gypsum mine in Juab County, Utah. The gypsum mine is located approximately 2 miles east of the town of Levan. This area is on the west slope of the San Pitch Mountains also known as the Gunnison Plateau. Elevation of the study site ranged from approximately 5,500 ft to nearly 7,500 ft above sea level.

Existing plant communities of the study site were comprised of mountain brush and other associated tree and shrub communities. These communities are described in greater detail in the following sections of this report. Aside from one area that has been proposed for future disturbance in about 5 years, most of the disturbance to the native plant communities have already been effected by mining activities. The intent of this report is to describe the natural, undisturbed plant communities that are similar and adjacent to those that have been impacted by mining activities. The description of these communities should drive the final revegetation plan and provide data for reasonable success standards to achieve the goals for post-mining landuse.

METHODS

Updated threatened, endangered and sensitive species lists for those species known to exist in the Uinta National Forest were provided by the USDA Forest Service. Species on these lists were evaluated when the work was done in the field and in preparation of this report.

Vegetation sampling methodologies used herein were performed in accordance with the guidelines supplied by the State of Utah, Division of Oil, Gas and Mining (DOGM). Quantitative and qualitative data were taken on the vegetation of the areas that had not been disturbed by mining activities in July and August 2000. The sample areas were adjacent to the previous disturbances, and in the same plant communities where mining has already taken place, but had not been disturbed or otherwise impacted by previous mining operations.

Transect and Quadrat Placement

Transect lines for sampling were placed in areas that appeared to be representative of the disturbance that has occurred at the site. A vegetation map of the permit area has been prepared for this report. This map also shows the locations of the sample transect lines.

Random/regular placement of sampling quadrats were designed to decrease bias, yet encompass a variety of surface areas. Once the transect lines were placed, regular points were then marked on them. From these marks, a random number dictated the direction and distance to place the quadrats at right angles from the transect lines.

Cover, Frequency and Composition

Cover estimates were made by using ocular methods with meter square quadrats. Species composition and relative frequencies (the relative number a given species is present in a sample) were also assessed from the quadrats. Additional information recorded on the raw data sheets were: estimated precipitation, slope, exposure, grazing use, animal disturbance and other appropriate notes. Plant nomenclature followed Welsh et al. (1993).

Woody Plant Species Density

Density of woody plant species of the areas were recorded using a distance method called the point-quarter. In this method, random points were placed on the sample sites and measured into four quarters. The distances to the nearest woody plant species were then recorded in each quarter. The average point-to-individual distance was equal to the square root of the mean area per individual.

Sample Adequacy

Because each transect site was so different (thus increasing variability) and the sample data were ultimately "lumped" together to provide average values, sample adequacy formulas were not applied to the data.

Wildlife

Information on the resident wildlife was done by accessing the State of Utah, Division of Wildlife Resource (DWR) GIS database for the study area.

Photographs

Color photographs of the sample areas were taken at the time of sampling and have been submitted with this report.

RESULTS

Vegetation

The plant communities of the Levan Gypsum Mine study site were generally comprised of mountain brush and shrubland communities. Community structure varied as a result of soil, exposure and other physiognomic features. For example, the steeper and drier sites appeared to support relatively more alder-leaf mountain mahogany *(Cercocarpus montanus)* but when the slope angle somewhat decreased, or had less exposure to the sun, soil depth appeared greater and more Gambel's oak *(Quercus gambelii)* was present. Therefore, there were areas that were dominated almost exclusively by mountain mahogany, whereas other areas were comprised mainly of Gambel's oak [see photo "General Plant Communities (1 of 2)]. Although the trees were scattered over the entire study site, there were other areas where pinyon pine *(Pinus edulis)* and Utah Juniper *(Juniperus osterosperma)* trees became major components. Still other patches, some of which were quite substantial, of greenleaf manzanita *(Arctostaphylos patula)* were not uncommon. One area in the somewhat mid- to lower- elevations was comprised of more grass cover than all other communities observed. The dominant species here were slender wheatgrass *(Elymus trachycaulus)* and mountain mahogany.

The lowest elevations of the study site were comprised of a riparian community adjacent to Chicken Creek, and by a Big Sagebrush/Grass (*Artemisia tridentata* and *Elymus spicatus*) community at a slightly higher elevation where alluvial material had been deposited [see photo "General Plant Communities (2 of 2)]. Although not abundant, the highest elevations of the permit area supported some conifer species. A vegetation map for the entire permit area of the Levan Gypsum Mine site has been prepared and included with this report .

Much of the area affected by mining operations were those communities that fell somewhat transitional between the communities described above – or was comprised of a fair representation of both mountain mahogany and Gambel's oak with scattered pinyon pine and juniper trees. The transect lines for quantitative sampling were placed in these areas – some of them were dominated by the oakbrush whereas others were dominated by the mountain mahogany. Transect No. 1 was placed in an area that had much total living cover and was dominated by mountain mahogany (see photo "Transect No. 1"). Transect No. 2 has much less total living cover and was dominated by

Gambel's oak (see photo "Transect No. 2"). Finally, a few samples were then placed in the more grassy areas also mentioned above (See photo "Transect No. 3"). The number of samples per transect was based on the relative importance by total acreage of that particular community. In other words, the sample transects were placed in areas that seemed to represent the most common plant communities and those that were most affected by mining operations. The transect data were "lumped" together in the summaries and analyses as another measure to provide appropriate data to represent the site as a whole and to simplify the standards for final reclamation.

Quantitative sampling in three different areas suggested that the average total living understory cover was 40.40%, whereas the overstory cover was estimated to be only 1.80%. Litter, bareground and rock were estimated at 11.00%, 10.00% and 38.60%, respectively (Table 1-A). Composition by lifeform showed that the woody species represented 76.65% of the total living understory cover, whereas, grasses were 20.98% and forbs were only 2.37% (Table 1-B).

The most common plant species by cover and frequency was mountain mahogany that average 18.60% cover and was present in 60.00% of the quadrats (Table 1-C). The next most common species was Gambel's oak which comprised a total cover of 5.00% with a frequency of 20.00%. Forbs were nearly negligible in the analyses all comprising less that 1.00% total cover. In most quadrats, grasses were also uncommon, however, some of the samples were placed in an area where grasses were common. The most prevalent species in this area were slender wheatgrass.

Woody species density measurements were also taken on the undisturbed areas of the mine site.

The total number of individuals per acre was 3,203 (Table 2). The most common woody species were also mountain mahogany and Gambel's oak.

Wildlife

A site-specific search was done using the State of Utah, Division of Wildlife Resource's GIS database. The search focused on high-profile, sensitive, rare, threatened and endangered wildlife species.

Results of the search showed that there are a total of five golden eagle nests withing a one-mile radius of the project area, three of which were within 0.5 miles from the area. There was no sage grouse habitat in the area. The project area is within the range for black bear. There were no sensitive, rare, threatened or endangered invertebrate species shown to be in the area. The database showed that elk use the area for summer and winter range, but not for calving. Although deer summer range is somewhat higher and not on the project area, the site is used by them for winter range. The area, however, is probably not used by deer for their fawning activities. Finally, the Chicken Creek riparian area is used extensively by many bird species.

Threatened, Endangered & Sensitive Species

Other than the bald eagle nests described above, no federally listed threatened or endangered (or sensitive) plant or animal species were observed or are known to be present on the study site.

SUMMARY & DISCUSSION

A description of the plant communities and critical wildlife species of an area that is currently being mined for gypsum has been reported with this document. The primary purpose of the study was to provide qualitative descriptions and quantitative data for plant communities that have been impacted by the mining operations so that the information can be used to drive the final revegetation plan to present a reasonable set of success standards to achieve the goals for post-mining landuse. Additionally, the study focused on high-profile, sensitive, rare, threatened or endangered wildlife and plant species.

The limit to the extent of disturbance to the existing plant communities and wildlife habitats by current mining activities has been made for the next 5 years. Another undisturbed area planned for future mining activities has proposed (see photo "Future Mine Area"). The vegetation in this area has been mapped for the scope of this report, but prior to disturbing these areas in the future, an amendment to the mining plan will be submitted to the State of Utah, Division of Oil, Gas & Mining including quantitative data summaries that specifically address the plant communities that will be impacted.

TABLE 1: Summary of total cover, composition and cover by species of the undisturbed areas of the Levan Gypsum Mine.

A.

TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE
Overstory	1.80	7.86	25
Understory	40.40	20.05	25
Total Living	42.20	19.95	25
Litter	11.00	9.27	25
Bareground	10.00	7.35	25
Rock	38.60	23.56	25

B.

COMPOSITION	PERCENT	STANDARD DEVIATION	SAMPLE SIZE
Shrubs	76.65	34.17	25
Forbs	2.37	5.87	25
Grasses	20.98	35.11	25

C.

COVER BY SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
<u>Trees & Shrubs</u> (overstory)				
Juniperus osteosperma	0.20	0.98	25	4.00
Quercus gambelii	1.60	7.84	25	4.00
<u>Trees & Shrubs</u> (understory)				
Cercocarpus montanus	18.60	21.33	25	60.00
Chrysothamnus depressus	1.20	4.07	25	12.00
Juniperus osteosperma	0.60	2.94	25	4.00
Leptodactylon pungens	3.40	5.04	25	36.00
Mahonia repens	1.52	3.01	25	24.00
Pachystima myrsinites	1.40	3.01	25	20.00
Peraphyllum ramosissimum	1.40	6.86	25	4.00
Quercus gambelii	5.00	13.64	25	20.00
<u>Forbs</u>				
Cryptantha sp.	0.32	1.12	25	8.00
Machaeranthera canescens	0.28	1.04	25	8.00
Stellaria jamesiana	0.08	0.39	25	4.00
Wyethia amplexicaulis	0.20	0.98	25	4.00
<u>Grasses</u>				
Stipa hymenoides	1.80	7.05	25	8.00
Elymus trachycaulus	4.60	9.76	25	20.00

<u>TABLE 2</u>: Summary for woody species density of the undisturbed areas of the Levan Gypsum Mine.

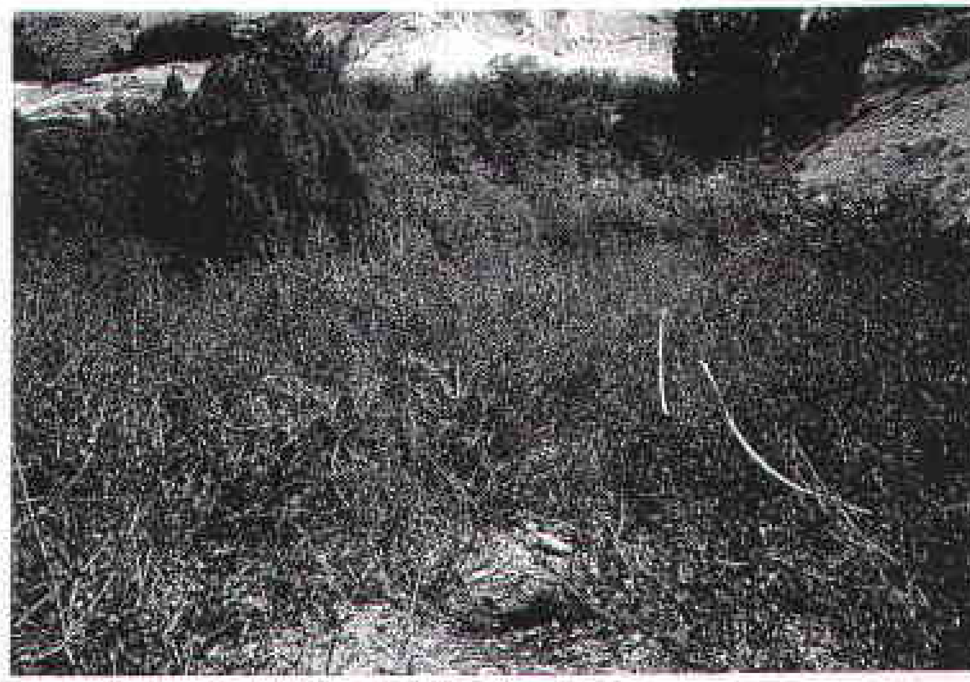
A.

WOODY SPECIES DENSITY	NUMBER/ACRE
Artemisia tridentata	32.03
Cercocarpus montanus	1889.95
Chrysothamnus depressus	160.17
Gutierrezia sarothrae	32.03
Juniperus osteosperma	32.03
Mahonia repens	320.33
Pachystima myrsinites	96.10
Peraphyllum ramosissimum	64.07
Pinus edulis	32.03
Quercus gambelii	544.56
TOTAL	3203.31

COLOR PHOTOGRAPHS

General Plant Communities (1 of 2)

General Plant Communities (2 of 2)



Transect No. 1

Transect No.2

Transect No. 3

Future Mine Area

APPENDIX 107-2

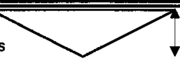
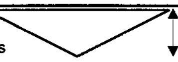
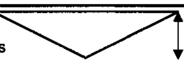
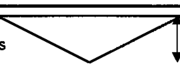
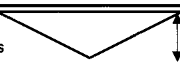
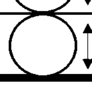
OPERATIONAL HYDROLOGY CALCULATIONS

Operational Hydrology Calculation Summary
Chicken Creek Mine
Drainage Channel and Pipe Parameters

Channel / Reach	X-section	100yr, 0.5hr Max Flow (cfs)	Avg. Slope (ft/ft)	Max Depth (ft)	Max Vel. (fps)	D_{50} Riprap (in)	Manning's n*
East #1	10h:1v slopes 1'	25.1	0.0724	0.59	7.90	6	0.022
East #2	10h:1v slopes 10' 1'	63.91	0.0344	0.64	7.43	6	0.022
West #1	10h:1v slopes 1'	5.09	0.0286	0.37	3.72	2	0.022
West #2	10h:1v slopes 1'	15.09	0.0175	0.61	4.04	2	0.022
West #4 / #0	2h:1v slopes 1'	1.66	0.4199	0.38	5.87	3	0.050
West #4 / #1	2h:1v slopes 1'	1.41	0.5185	0.34	6.09	6	0.050
West #4 / #2	2h:1v slopes 1'	2.28	0.2813	0.46	5.47	4	0.050
West #5 / #1	2h:1v slopes 0.75'	0.58	0.0903	0.25	4.70	3	0.220
West #5 / #2	2h:1v slopes 0.75'	1.17	0.1308	0.30	6.42	4	0.220
West #5 / #3	2h:1v slopes 0.8'	1.54	0.1511	0.33	7.27	6	0.220
West #5 / #4	2h:1v slopes 0.85'	1.85	0.1506	0.35	7.60	6	0.022
West #5 / #5	2h:1v slopes 0.9'	2.34	0.1038	0.41	7.01	6	0.022
West #5 / #6	2h:1v slopes 0.9'	3.3	0.1968	0.41	9.71	6	0.022
West #6 / #1	2h:1v slopes 0.7'	0.53	0.1500	0.22	5.54	3	0.022
West #6 / #2	2h:1v slopes 0.85'	0.77	0.0194	0.37	2.83	2	0.022
west #6 / #3	2h:1v slopes 0.75'	1	0.3838	0.23	9.26	9	0.022
West #7 / #2	2h:1v slopes 1'	6.28	0.1539	0.55	10.43	9	0.022
Pipe							
West #2	12"	1.46	0.3984	0.24	10.15	9	0.025

*Adjusted for riprap size according to USDOT FHWA HEC No. 11 and NUREG/CR 4651 (see Appx 107-2).
$n = 0.0456 \times (D_{50} \times S)^{0.159}$ where D_{50} (inches) is the mean riprap diameter and S (ft/ft) is the channel slope.
n values of 0.022 assume new clean straight man made channel. n value of 0.050 assume natural mountain channel with no alterations.
Calculations assume bottom of channel is graded at a relatively constant slope.

Operational Hydrology Calculation Summary
Chicken Creek Mine
Drainage Channel and Pipe Parameters

Channel / Reach	X-section	25yr, 6hr Max Flow (cfs)	Avg. Slope (ft/ft)	Max Depth (ft)	Max Vel. (fps)	D_{50} Riprap (in)	Manning's n*
#4 / #3	2h:1v slopes  1'	2.76	0.5779	0.43	7.51	10	0.050
#4 /#4	2h:1v slopes  1'	2.76	0.4162	0.46	6.64	9	0.022
#4 /#5	2h:1v slopes  1.1'	3.34	0.1835	0.53	6.06	4	0.040
#4 /#6	2h:1v slopes  1'	3.34	0.3333	0.47	7.58	3	0.040
#7 /#1	2h:1v slopes  0.75'	1.36	0.2609	0.28	8.65	7	0.022
#7 /#3	2h:1v slopes  1'	1.70	0.0351	0.44	4.31	2	0.022
Pipe							
#3	 12"	2.76	0.1716	0.41	8.97	6	0.025
#4	 15"	3.34	0.0278	0.70	4.76	3	0.025

*Adjusted for riprap size according to USDOT FHWA HEC No. 11 and NUREG/CR 4651 (see Appx 107-2).
$n = 0.0456 \times (D_{50} \times S)^{0.159}$ where D_{50} (inches) is the mean riprap diameter and S (ft/ft) is the channel slope.
n values of 0.022 assume new clean straight man made channel. N value of 0.040 assume existing man made channel. n value of 0.050 assume natural mountain channel with no alterations.
Calculations assume bottom of channel is graded at a relatively constant slope.

Operational Hydrology Calculation Summary
Chicken Creek Mine
Pond Overflow Parameters

Channel	X-section	25yr 6hr Max Flow (cfs)	Avg. Slope (ft/ft)	Max Depth (ft)	Max Vel. (fps)	D_{50} Riprap (in)	Manning's n*
West Pond #1	2h:1v slopes 1' 2'	8.17	0.0100	1.04	2.55	2	0.04
West Pond #2	2h:1v slopes 1' 2'	2.67	0.1000	0.36	4.49	2	0.04
West Pond #3 Top	2h:1v slopes 1' 2'	3.00	0.0560	0.43	3.72	2	0.04
West Pond #3 Bottom	2h:1v slopes 1' 2'	3.00	0.3333	0.27	7.09	6	0.04
West Pond #4 Top	2h:1v slopes 1' 2'	2.10	0.0560	0.36	3.38	2	0.04
West Pond #4 Bottom	2h:1v slopes 1' 2'	2.10	0.3333	0.23	6.4	4	0.04
West Pond #5 Top	2h:1v slopes 1' 2'	1.70	0.1500	0.25	4.54	3	0.04
West Pond #5 Bottom	2h:1v slopes 1' 2'	1.70	0.3333	0.20	6.02	4	0.04
East Pond #1 Top	3h:1v slopes 5' 2'	17.56	0.0100	0.86	2.70	2	0.04
East Pond #1 Bottom	3h:1v slopes 5' 1'	17.56	0.3333	0.33	9.02	8	0.04
East Pond #2 Top	3h:1v slopes 5' 2'	14.69	0.0100	0.78	2.57	2	0.04
East Pond #2 Bottom	3h:1v slopes 5' 1'	14.69	0.3333	0.29	8.50	8	0.04

*Adjusted for riprap size according to USDOT FHWA HEC No. 11 and NUREG/CR 4651 (see Appx 107-1)

$n = 0.0456 \times (D_{50} \times S)^{0.159}$ where D_{50} (inches) is the mean riprap diameter and S (ft/ft) is the channel slope

Calculations assume bottom of channel is graded at a relatively constant slope

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 39.525 N 111.913 W 5137 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Tue May 19 2009

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Docs | Return to State Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.12	0.17	0.22	0.29	0.36	0.45	0.51	0.66	0.82	1.03	1.17	1.36	1.59	1.79	2.34	2.81	3.54	4.19
2	0.15	0.23	0.28	0.38	0.46	0.57	0.64	0.81	1.01	1.27	1.43	1.68	1.97	2.21	2.89	3.47	4.35	5.17
5	0.21	0.31	0.39	0.52	0.65	0.76	0.83	1.01	1.24	1.53	1.74	2.06	2.40	2.68	3.47	4.17	5.18	6.14
10	0.26	0.39	0.48	0.65	0.81	0.93	0.99	1.18	1.42	1.75	1.99	2.38	2.76	3.05	3.92	4.72	5.83	6.89
25	0.34	0.51	0.63	0.83	1.05	1.20	1.25	1.41	1.67	2.04	2.35	2.82	3.25	3.56	4.50	5.46	6.67	7.84
50	0.40	0.62	0.76	1.03	1.27	1.43	1.48	1.61	1.86	2.26	2.62	3.18	3.63	3.94	4.84	6.00	7.30	8.53
100	0.48	0.74	0.91	1.22	1.52	1.70	1.73	1.85	2.07	2.49	2.92	3.56	4.03	4.34	5.37	6.55	7.91	9.20
200	0.58	0.88	1.09	1.46	1.81	2.01	2.04	2.12	2.31	2.72	3.22	3.96	4.43	4.73	5.78	7.10	8.51	9.85
500	0.72	1.09	1.36	1.83	2.26	2.49	2.52	2.61	2.76	3.03	3.63	4.30	4.98	5.26	6.32	7.80	9.27	10.65
1000	0.85	1.29	1.60	2.15	2.60	2.93	2.96	3.04	3.17	3.26	3.95	4.95	5.41	5.67	6.71	8.32	9.82	11.22

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

*** Upper bound of the 90% confidence interval**
Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.14	0.21	0.26	0.34	0.42	0.52	0.58	0.73	0.91	1.11	1.25	1.47	1.71	1.92	2.50	3.01	3.76	4.46
2	0.17	0.26	0.33	0.44	0.55	0.66	0.73	0.91	1.12	1.36	1.55	1.81	2.12	2.38	3.08	3.72	4.64	5.51
5	0.24	0.37	0.46	0.61	0.76	0.88	0.94	1.13	1.36	1.65	1.87	2.21	2.57	2.87	3.71	4.47	5.53	6.55
10	0.30	0.46	0.57	0.77	0.95	1.07	1.13	1.31	1.56	1.88	2.14	2.55	2.95	3.27	4.18	5.06	6.22	7.35
25	0.39	0.60	0.74	1.00	1.24	1.38	1.42	1.58	1.84	2.19	2.53	3.03	3.47	3.81	4.81	5.85	7.12	8.37
50	0.48	0.73	0.90	1.21	1.50	1.66	1.67	1.82	2.07	2.43	2.83	3.42	3.89	4.23	5.29	6.45	7.80	9.11
100	0.58	0.88	1.09	1.46	1.81	1.99	2.01	2.10	2.31	2.68	3.15	3.83	4.32	4.66	5.75	7.04	8.47	9.84
200	0.69	1.05	1.30	1.75	2.17	2.37	2.40	2.44	2.61	2.94	3.48	4.27	4.77	5.10	6.21	7.64	9.13	10.56
500	0.88	1.34	1.66	2.23	2.76	3.00	3.02	3.05	3.16	3.29	3.95	4.89	5.38	5.69	6.82	8.44	9.99	11.46
1000	1.05	1.59	1.98	2.66	3.30	3.58	3.62	3.65	3.67	3.71	4.32	5.40	5.88	6.16	7.28	9.03	10.63	12.12

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

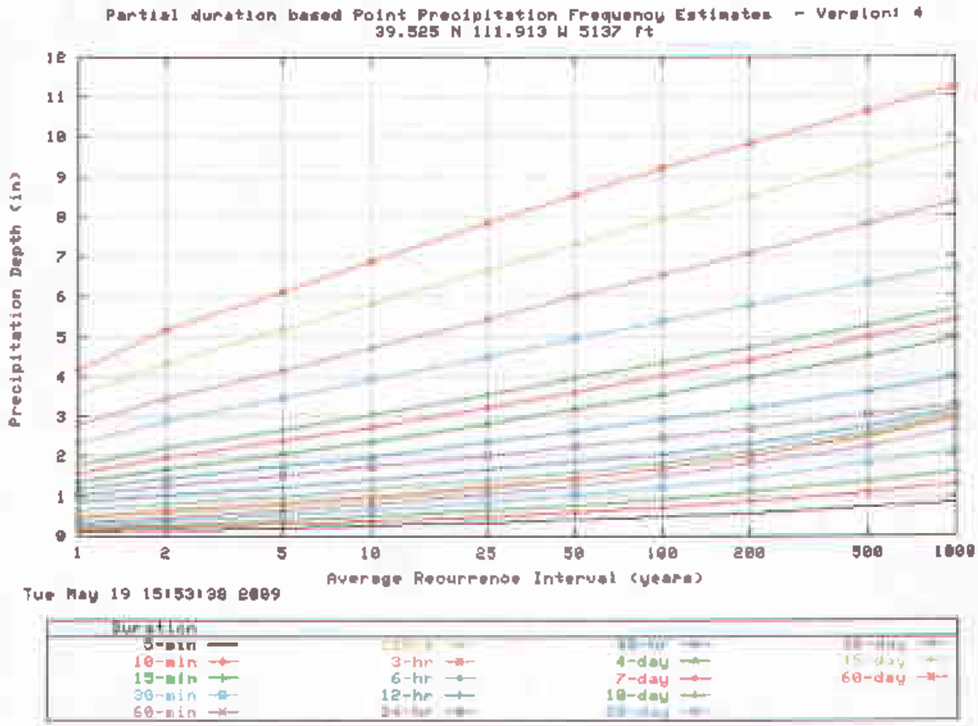
*** Lower bound of the 90% confidence interval**
Precipitation Frequency Estimates (inches)

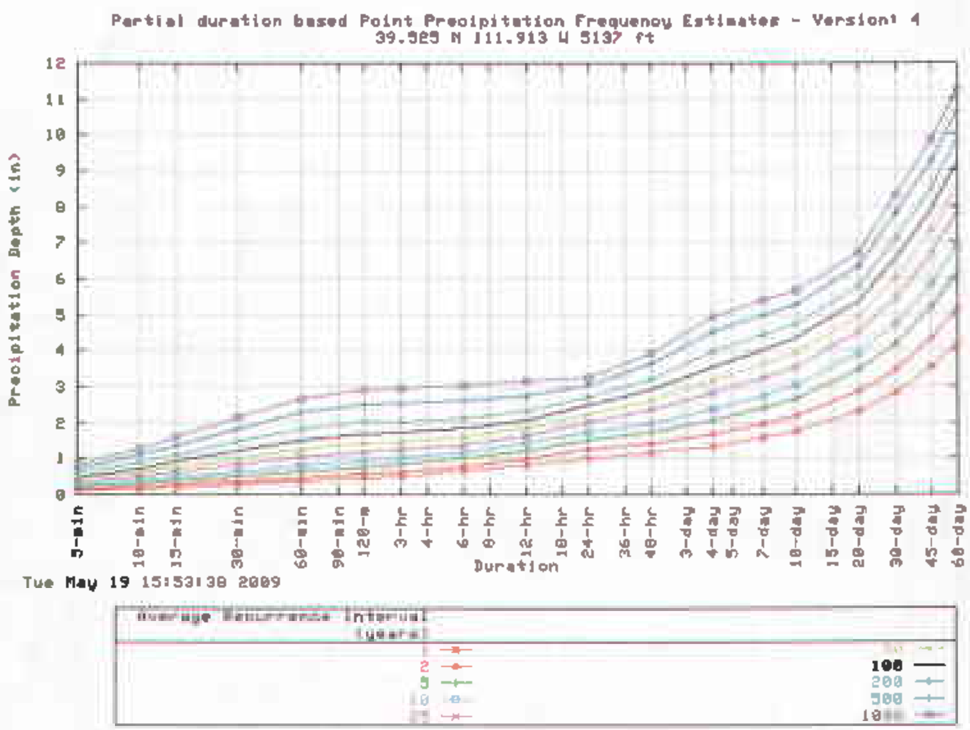
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.10	0.15	0.19	0.25	0.31	0.40	0.46	0.59	0.76	0.96	1.09	1.27	1.50	1.67	2.20	2.63	3.32	3.94
2	0.13	0.20	0.24	0.33	0.40	0.51	0.57	0.74	0.93	1.18	1.34	1.57	1.85	2.07	2.71	3.24	4.09	4.86
5	0.18	0.27	0.33	0.45	0.56	0.67	0.74	0.91	1.13	1.43	1.62	1.92	2.24	2.50	3.23	3.88	4.86	5.77
10	0.22	0.33	0.41	0.56	0.69	0.81	0.88	1.06	1.29	1.63	1.86	2.21	2.57	2.84	3.67	4.39	5.46	6.46
25	0.28	0.42	0.53	0.71	0.88	1.02	1.09	1.25	1.51	1.89	2.18	2.61	3.02	3.31	4.21	5.06	6.24	7.34
50	0.33	0.50	0.62	0.84	1.04	1.20	1.25	1.42	1.67	2.09	2.42	2.92	3.36	3.63	4.60	5.55	6.80	7.96
100	0.39	0.59	0.73	0.98	1.22	1.38	1.43	1.60	1.83	2.29	2.67	3.24	3.71	3.99	4.98	6.04	7.35	8.56
200	0.45	0.68	0.85	1.14	1.41	1.59	1.68	1.81	2.02	2.49	2.93	3.58	4.05	4.33	5.34	6.51	7.86	9.13
500	0.54	0.82	1.01	1.36	1.69	1.90	2.00	2.16	2.36	2.75	3.27	4.03	4.50	4.77	5.80	7.09	8.51	9.81
1000	0.61	0.93	1.15	1.55	1.92	2.15	2.27	2.46	2.67	2.94	3.52	4.37	4.83	5.10	6.12	7.52	8.97	10.28

* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.

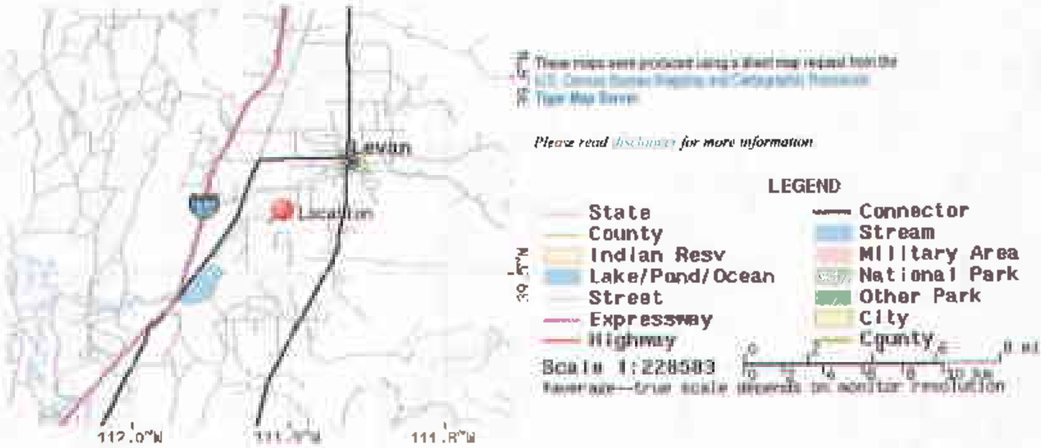
* These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Text version of tables





Maps -



Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; USGS **Aerial Photograph** may also be available from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study, please refer to NOAA Atlas 14 Document.

Using the National Climatic Data Center's (NCDC) station search engine, locate other climate stations within:

+/-30 minutes OR +/-1 degree of this location (39.525/-111.913). Digital ASCII data can be obtained directly from NCDC.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the Western Regional Climate Center's state-specific SNOTEL station maps.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910
(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

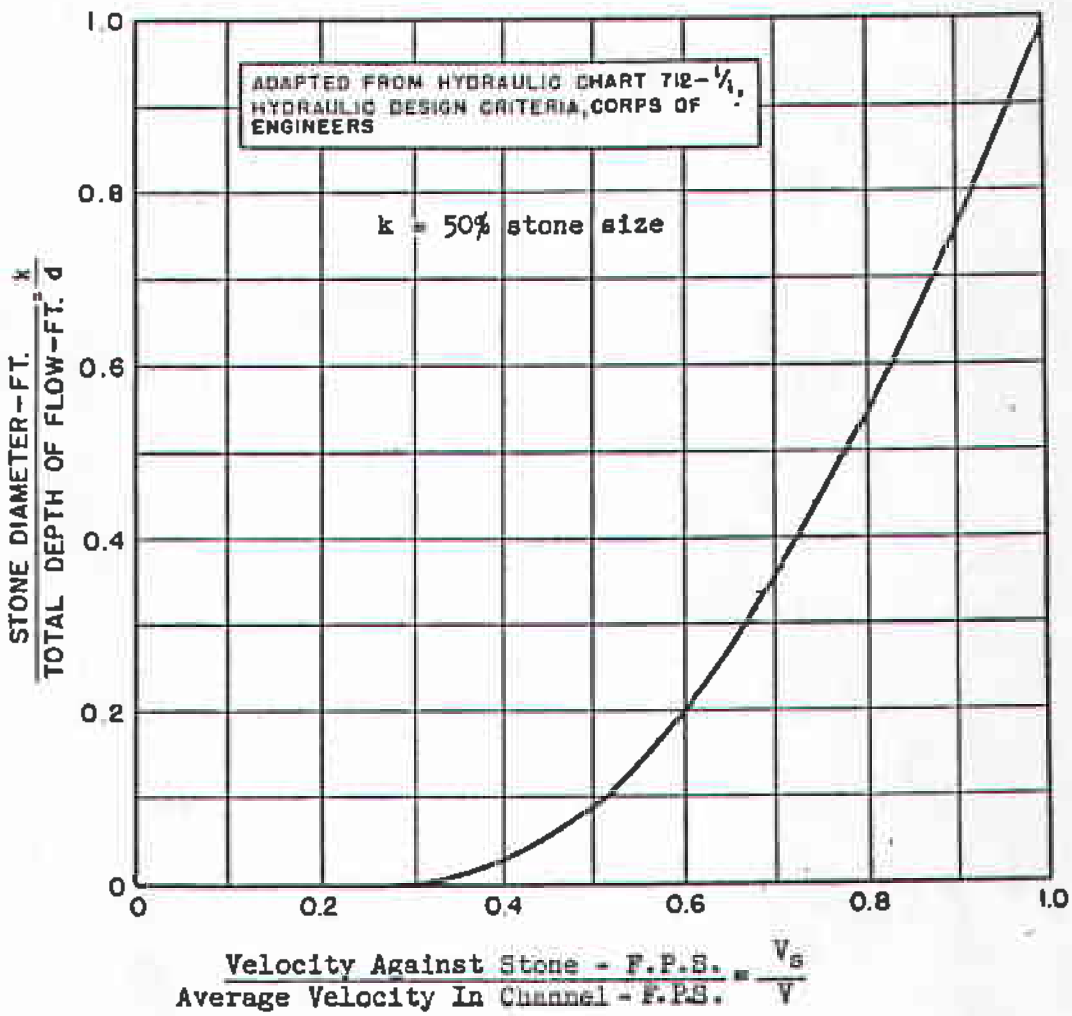


FIGURE 5-1 Velocity Against Stone on Channel Bottom (U.S. Department of Transportation, 1978).

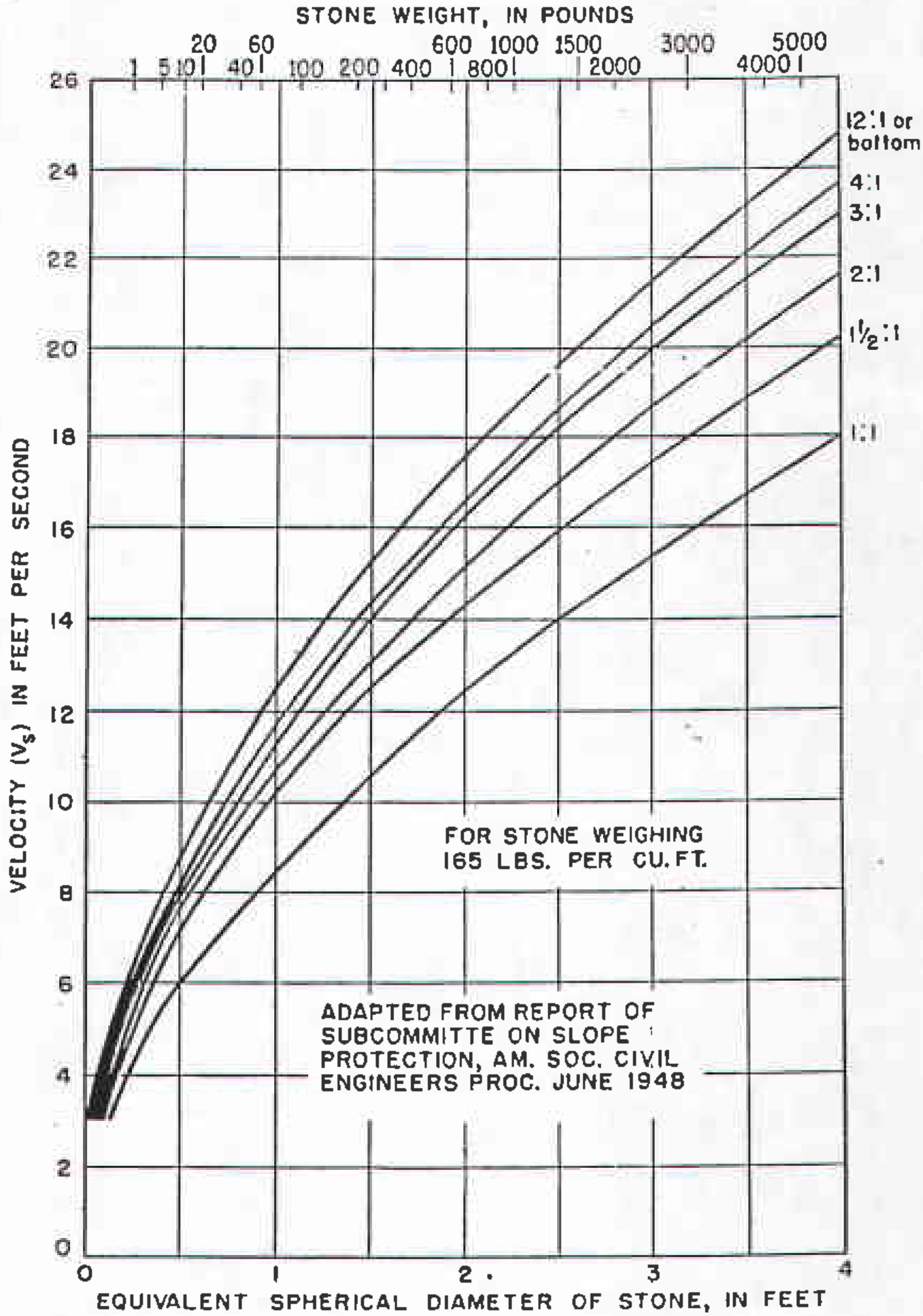
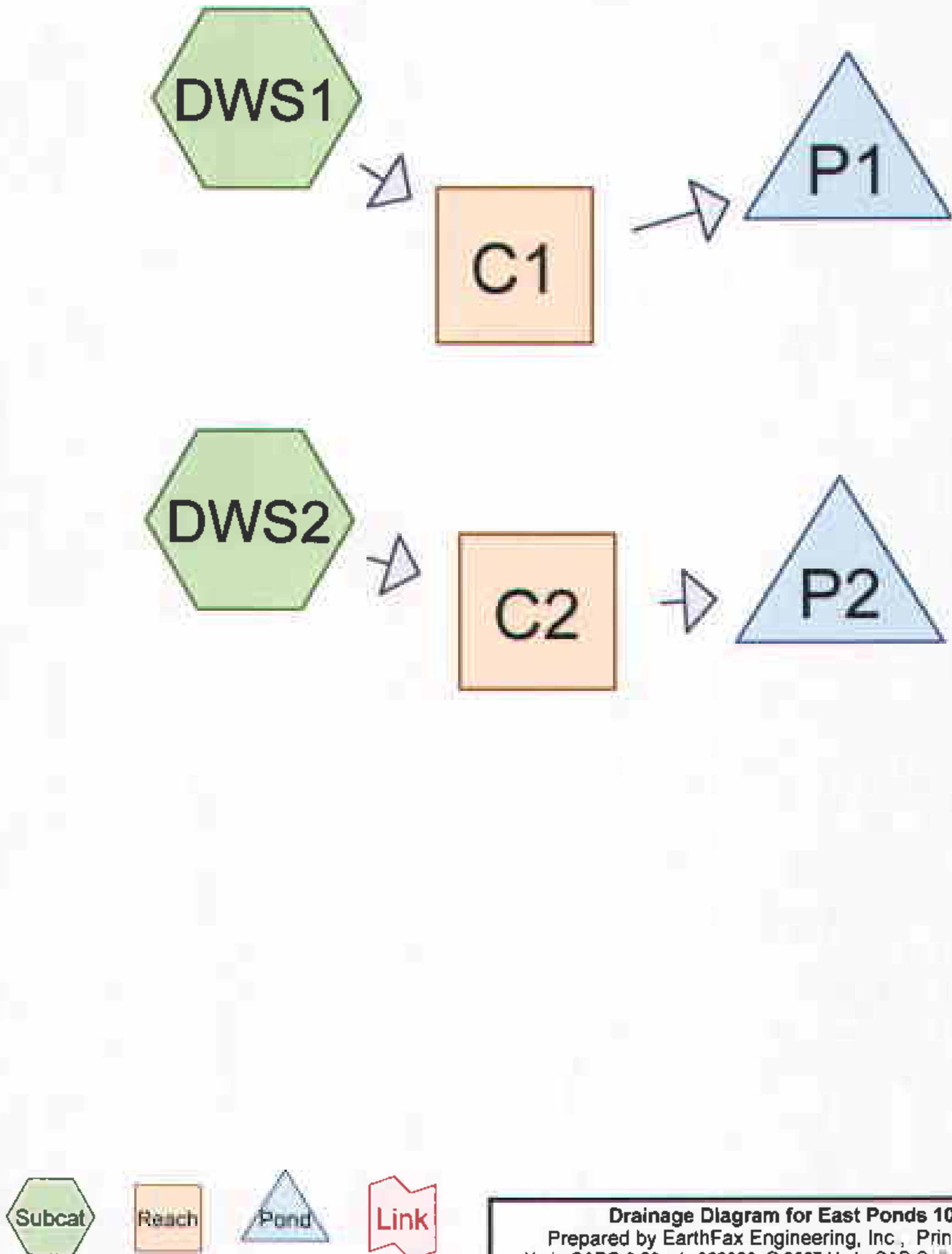


FIGURE 5-2 Size of Stone that will Resist Displacement for Various Velocities and Side Slopes (U.S. Department of Transportation, 1978).



Drainage Diagram for East Ponds 10yr, 24hr
Prepared by EarthFax Engineering, Inc , Printed 5/13/2009
HydroCAD® 8 50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DWS1: Runoff Area=14.800 ac 0.00% Impervious Runoff Depth=0.66"
Flow Length=1,680' Slope=0.5090 '/' Tc=5.5 min CN=86 Runoff=17.27 cfs 0.820 af

Subcatchment DWS2: Runoff Area=37.100 ac 0.00% Impervious Runoff Depth=0.66"
Flow Length=1,490' Slope=0.5770 '/' Tc=4.7 min CN=86 Runoff=44.97 cfs 2.055 af

Reach C1: Avg. Depth=0.48' Max Vel=7.04 fps Inflow=17.27 cfs 0.820 af
n=0.022 L=870.0' S=0.0724 '/' Capacity=114.12 cfs Outflow=15.79 cfs 0.820 af

Reach C2: Avg. Depth=0.47' Max Vel=6.22 fps Inflow=44.97 cfs 2.055 af
n=0.022 L=640.0' S=0.0344 '/' Capacity=190.72 cfs Outflow=40.97 cfs 2.055 af

Pond P1: Peak Elev=5,676.14' Storage=35,712 cf Inflow=15.79 cfs 0.820 af
Outflow=0.00 cfs 0.000 af

Pond P2: Peak Elev=5,715.94' Storage=89,520 cf Inflow=40.97 cfs 2.055 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 51.900 ac Runoff Volume = 2.875 af Average Runoff Depth = 0.66"
100.00% Pervious = 51.900 ac 0.00% Impervious = 0.000 ac

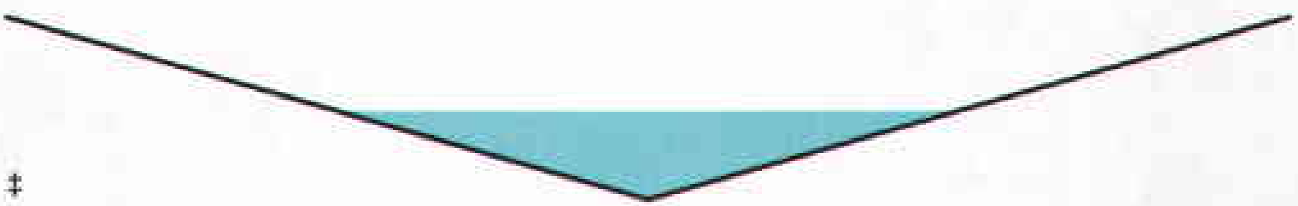
Summary for Reach C1:

Inflow Area = 14.800 ac, 0.00% Impervious, Inflow Depth = 0.66"
Inflow = 17.27 cfs @ 11.97 hrs, Volume= 0.820 af
Outflow = 15.79 cfs @ 12.03 hrs, Volume= 0.820 af, Atten= 9%, Lag= 3.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.04 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 2.52 fps, Avg. Travel Time= 5.7 min

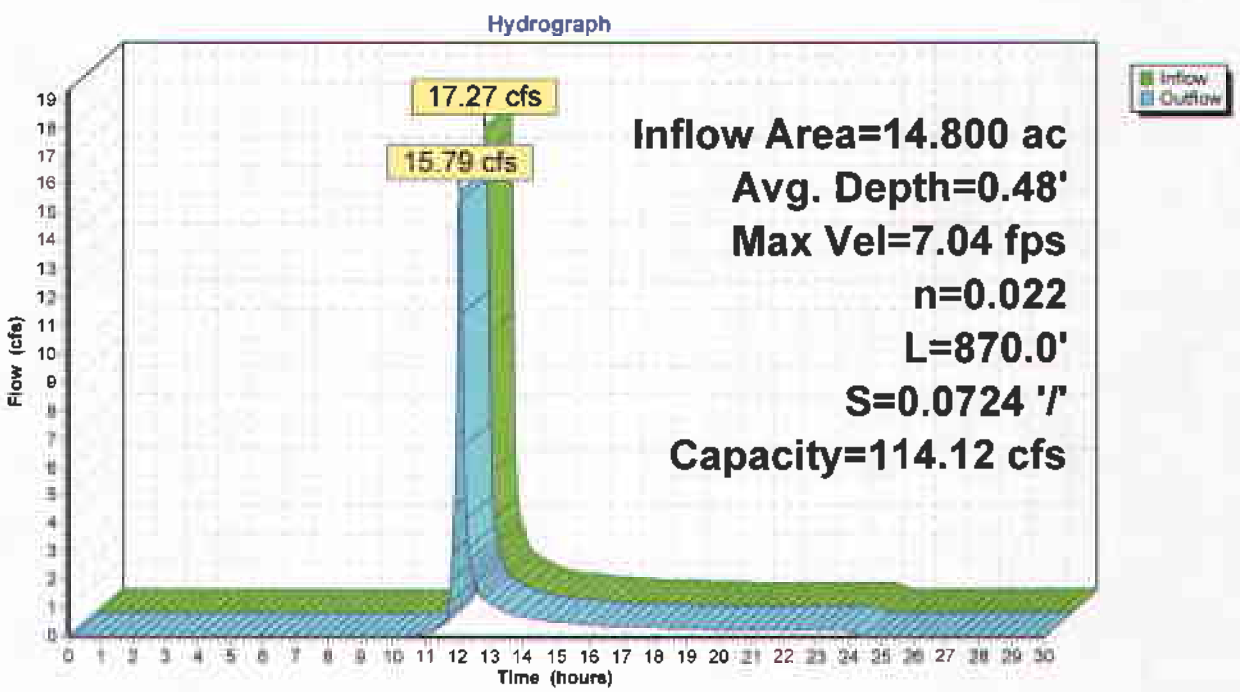
Peak Storage= 2,044 cf @ 12.00 hrs, Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 114.12 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 20.00'
Length= 870.0' Slope= 0.0724 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,677.00'



‡

Reach C1:



Summary for Reach C2:

Inflow Area = 37.100 ac, 0.00% Impervious, Inflow Depth = 0.66"
Inflow = 44.97 cfs @ 11.96 hrs, Volume= 2.055 af
Outflow = 40.97 cfs @ 12.01 hrs, Volume= 2.055 af, Atten= 9%, Lag= 2.9 min

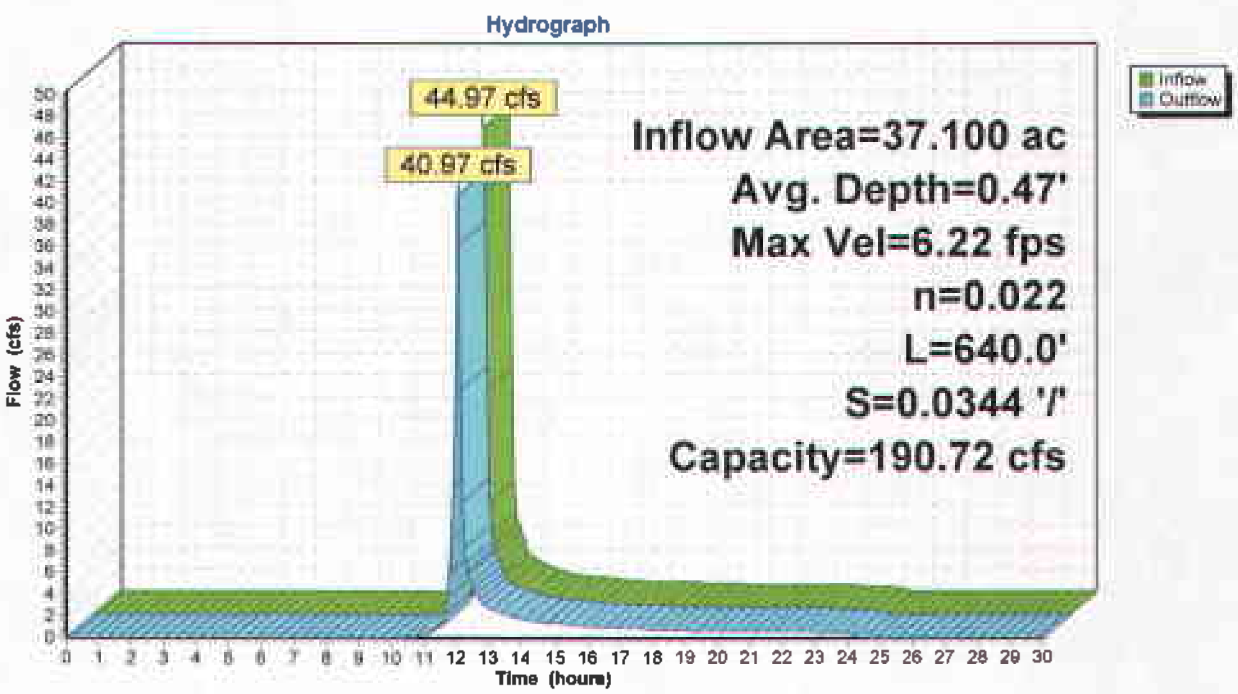
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.22 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.61 fps, Avg. Travel Time= 6.6 min

Peak Storage= 4,404 cf @ 11.98 hrs, Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 190.72 cfs

10.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 30.00'
Length= 640.0' Slope= 0.0344 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,718.00'

‡

Reach C2:



Summary for Pond P1:

Inflow Area = 14.800 ac, 0.00% Impervious, Inflow Depth = 0.66"
Inflow = 15.79 cfs @ 12.03 hrs, Volume= 0.820 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

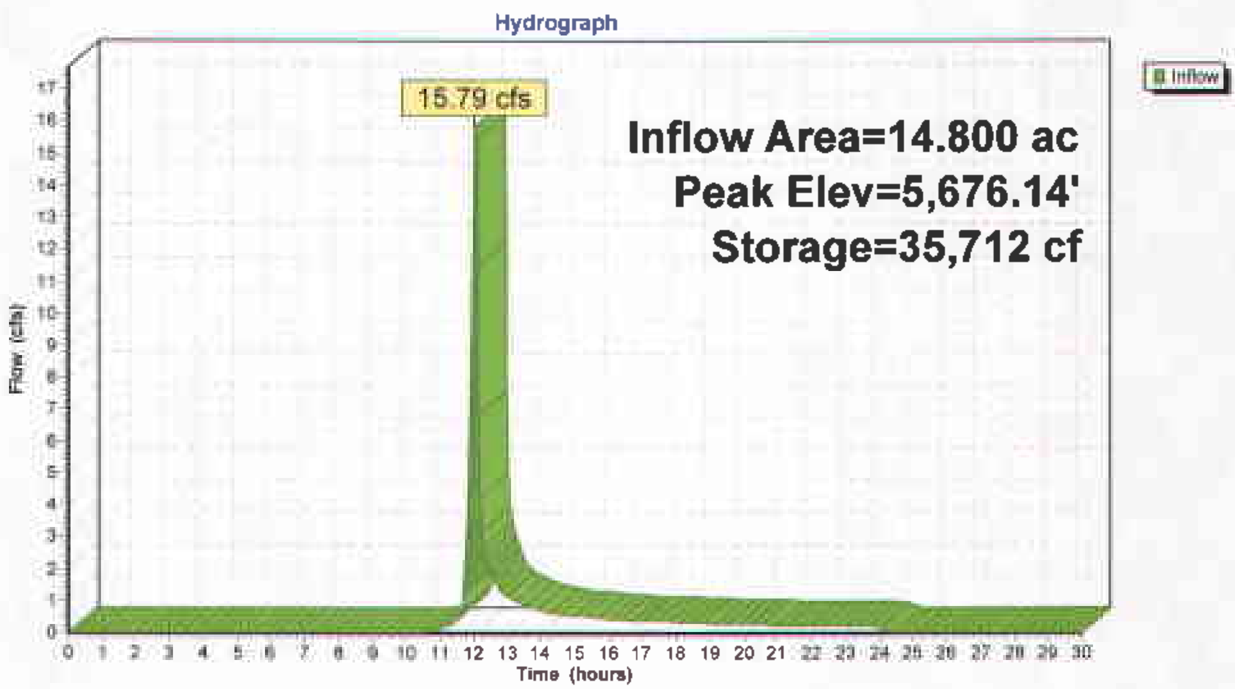
Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 5,676.14' @ 30.00 hrs Surf.Area= 0 sf Storage= 35,712 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,662.00'	44,057 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
5,662.00	0
5,664.00	747
5,666.00	2,725
5,668.00	5,849
5,670.00	10,380
5,672.00	16,573
5,674.00	24,665
5,676.00	34,880
5,676.15	35,775
5,677.50	44,057

Pond P1:



Summary for Pond P2:

Inflow Area = 37.100 ac, 0.00% Impervious, Inflow Depth = 0.66"
Inflow = 40.97 cfs @ 12.01 hrs, Volume= 2.055 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

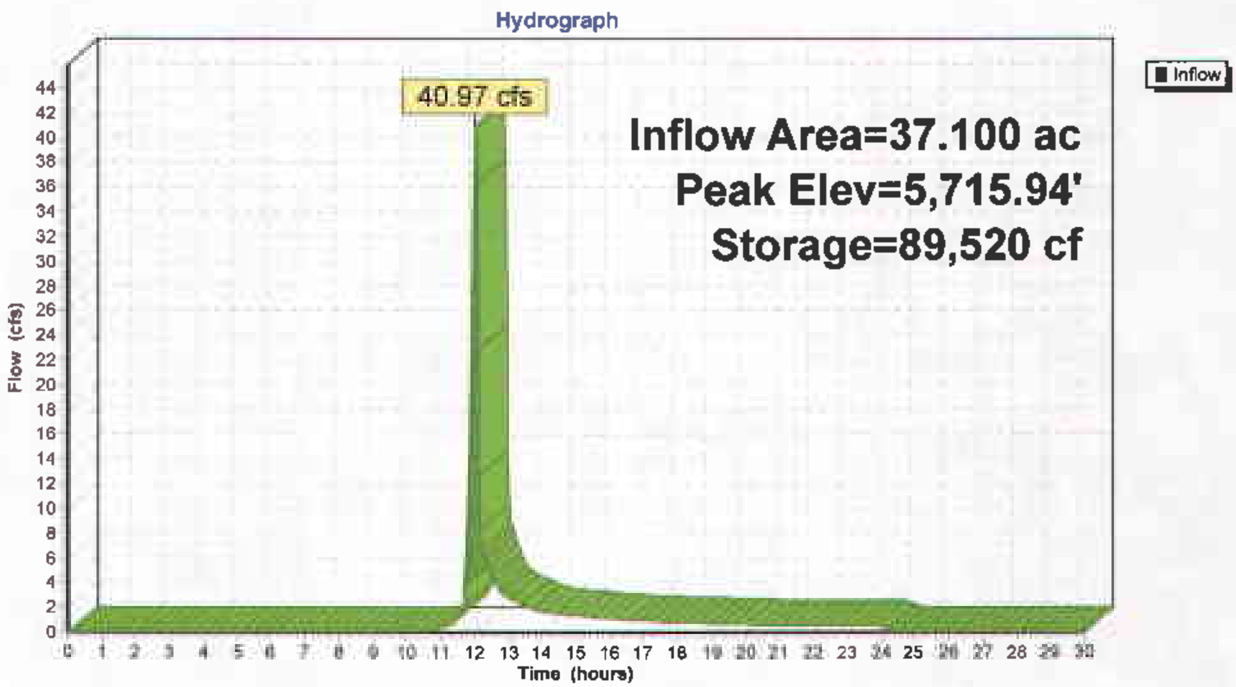
Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 5,715.94' @ 30.00 hrs Surf.Area= 12,748 sf Storage= 89,520 cf

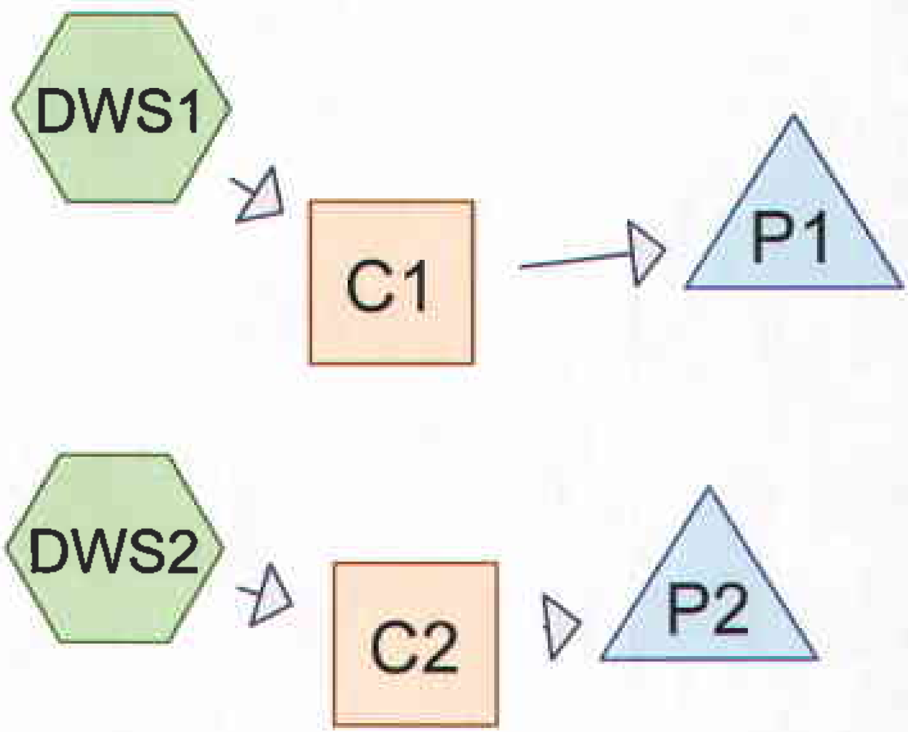
Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

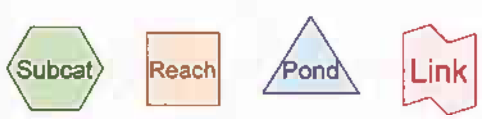
Volume	Invert	Avail.Storage	Storage Description
#1	5,704.00'	117,824 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,704.00	0	0	0
5,706.00	4,800	4,800	4,800
5,708.00	6,144	10,944	15,744
5,710.00	7,616	13,760	29,504
5,712.00	9,216	16,832	46,336
5,714.00	10,944	20,160	66,496
5,716.00	12,800	23,744	90,240
5,718.00	14,784	27,584	117,824

Pond P2:







Drainage Diagram for East Ponds 25yr, 6hr
Prepared by EarthFax Engineering, Inc , Printed 5/13/2009

Time span=0.00-12.00 hrs, dt=0.05 hrs, 241 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentDWS1: Runoff Area=14.800 ac 0.00% Impervious Runoff Depth=0.43"
Flow Length=1,680' Slope=0.5090 '/' Tc=5.5 min CN=86 Runoff=23.33 cfs 0.535 af

SubcatchmentDWS2: Runoff Area=37.100 ac 0.00% Impervious Runoff Depth=0.43"
Flow Length=1,490' Slope=0.5770 '/' Tc=4.7 min CN=86 Runoff=59.56 cfs 1.340 af

Reach C1: Avg. Depth=0.51' Max Vel=7.23 fps Inflow=23.33 cfs 0.535 af
n=0.022 L=870.0' S=0.0724 '/' Capacity=114.12 cfs Outflow=18.23 cfs 0.535 af

Reach C2: Avg. Depth=0.53' Max Vel=6.68 fps Inflow=59.56 cfs 1.340 af
n=0.022 L=640.0' S=0.0344 '/' Capacity=190.72 cfs Outflow=48.35 cfs 1.340 af

Pond P1: Peak Elev=5,676.26' Storage=661 cf Inflow=18.23 cfs 0.535 af
Outflow=17.56 cfs 0.535 af

Pond P2: Peak Elev=5,716.10' Storage=25,029 cf Inflow=48.35 cfs 1.340 af
Outflow=14.69 cfs 0.795 af

Total Runoff Area = 51.900 ac Runoff Volume = 1.875 af Average Runoff Depth = 0.43"
100.00% Pervious = 51.900 ac 0.00% Impervious = 0.000 ac

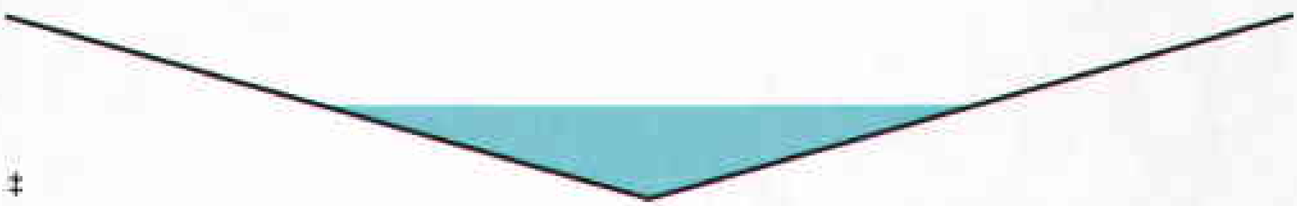
Summary for Reach C1:

Inflow Area = 14.800 ac, 0.00% Impervious, Inflow Depth = 0.43"
Inflow = 23.33 cfs @ 3.05 hrs, Volume= 0.535 af
Outflow = 18.23 cfs @ 3.11 hrs, Volume= 0.535 af, Atten= 22%, Lag= 3.9 min

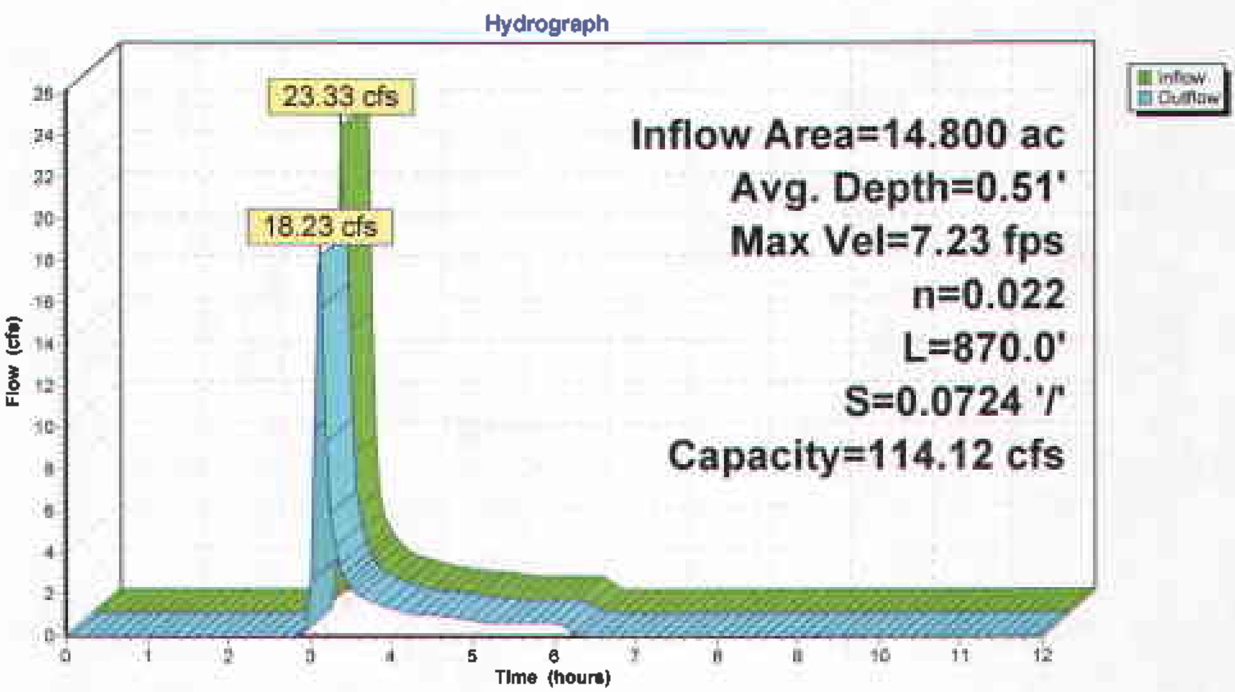
Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.23 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 2.56 fps, Avg. Travel Time= 5.7 min

Peak Storage= 2,276 cf @ 3.08 hrs, Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 114.12 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 20.00'
Length= 870.0' Slope= 0.0724 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,677.00'



Reach C1:



Summary for Reach C2:

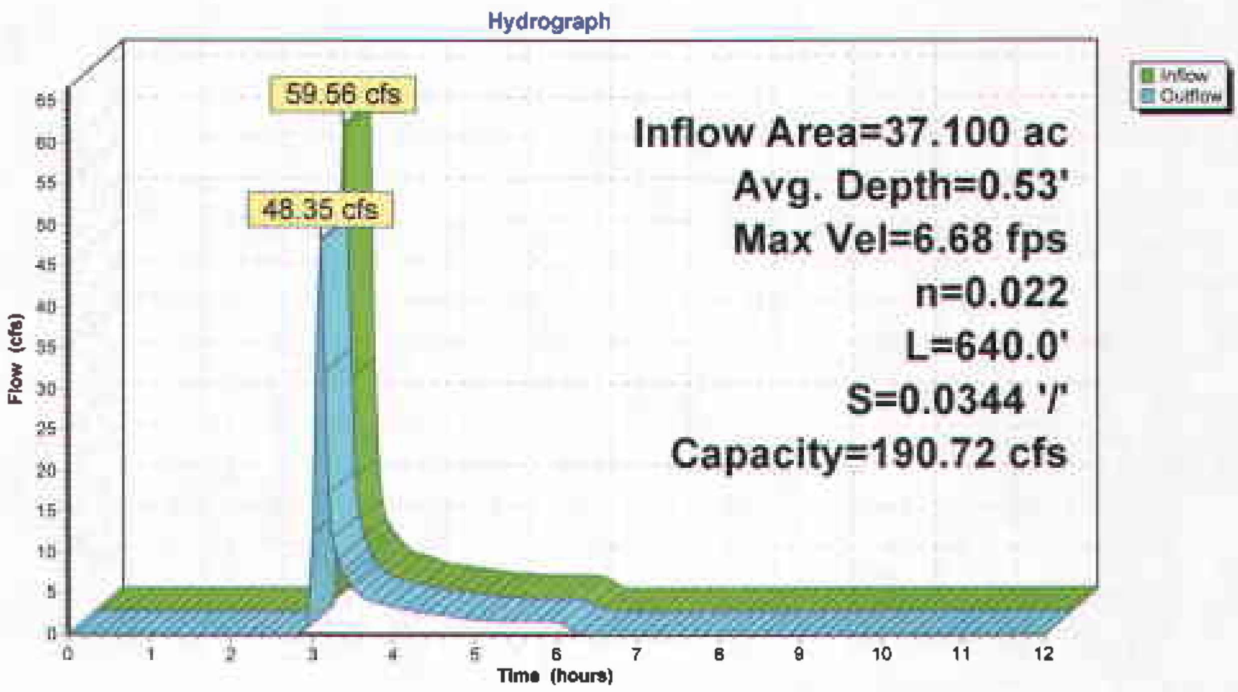
Inflow Area = 37.100 ac, 0.00% Impervious, Inflow Depth = 0.43"
Inflow = 59.56 cfs @ 3.04 hrs, Volume= 1.340 af
Outflow = 48.35 cfs @ 3.10 hrs, Volume= 1.340 af, Atten= 19%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.68 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.78 fps, Avg. Travel Time= 6.0 min

Peak Storage= 5,208 cf @ 3.06 hrs, Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 190.72 cfs

10.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 30.00'
Length= 640.0' Slope= 0.0344 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,718.00'

Reach C2:



Summary for Pond P1:

Inflow Area = 14.800 ac, 0.00% Impervious, Inflow Depth = 0.43"
Inflow = 18.23 cfs @ 3.11 hrs, Volume= 0.535 af
Outflow = 17.56 cfs @ 3.13 hrs, Volume= 0.535 af, Atten= 4%, Lag= 0.9 min
Primary = 17.56 cfs @ 3.13 hrs, Volume= 0.535 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Peak Elev= 5,676.26' @ 3.13 hrs Surf.Area= 0 sf Storage= 661 cf

Plug-Flow detention time= 0.6 min calculated for 0.533 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (225.0 - 224.3)

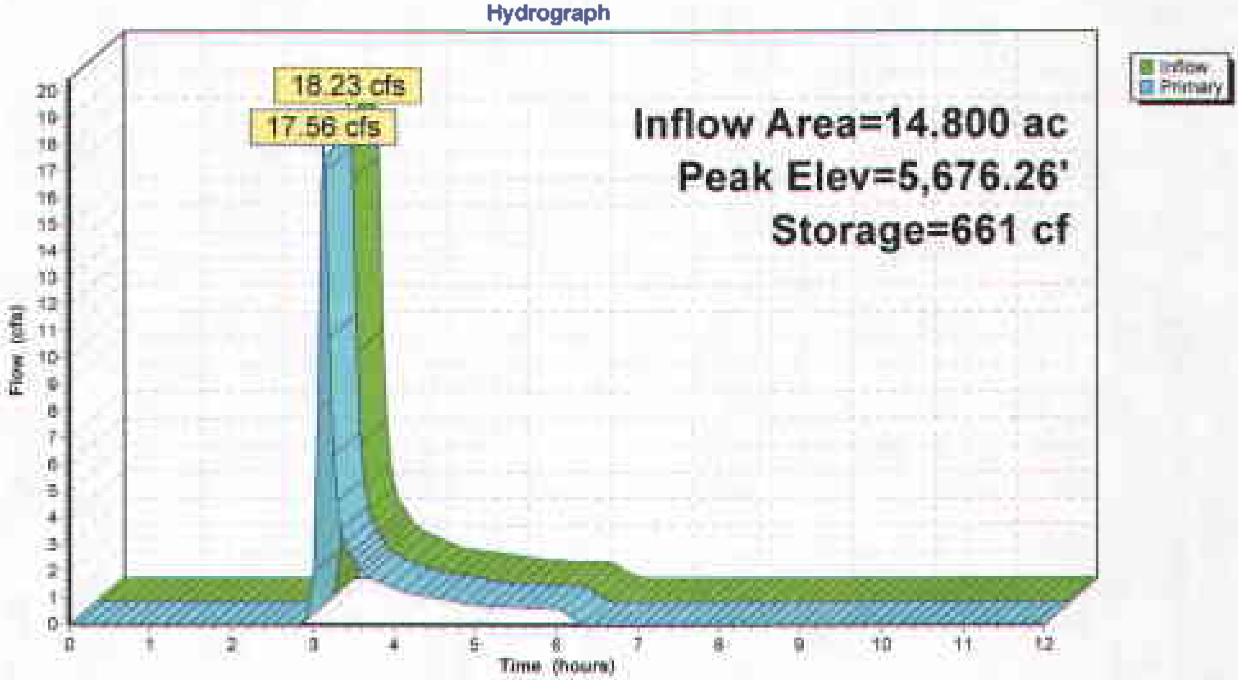
Volume	Invert	Avail.Storage	Storage Description
#1	5,676.15'	8,320 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
5,676.15	0
5,677.00	5,109
5,677.50	8,320

Device	Routing	Invert	Outlet Devices
#1	Primary	5,676.15'	**Special & User-Defined** Head (feet) 0.00 0.11 Disch. (cfs) 0.000 17.560

Primary OutFlow Max=16.72 cfs @ 3.13 hrs HW=5,676.25' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 16.72 cfs)

Pond P1:


Hydrograph
18.23 cfs
17.56 cfs
Inflow Area=14.800 ac
Peak Elev=5,676.26'
Storage=661 cf
Inflow
Primary
Flow (cfs)
Time (hours)

East Pond #1 Spillway Top
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	East Pond 1 Top
Flow Element	Trapezoidal Cha
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	010000	ft/ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	17.56	cfs

Results		
Depth	0.86	ft
Flow Area	6.5	ft²
Wetted Perim	10.46	ft
Top Width	10.18	ft
Critical Depth	0.63	ft
Critical Slope	0.030350	ft/ft
Velocity	2.70	ft/s
Velocity Head	0.11	ft
Specific Energ	0.97	ft
Froude Numb	0.60	
Flow Type	Subcritical	

East Pond #1 Spillway Bttom
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	East Pond 1 Bot
Flow Element	Trapezoidal Cha
Method	Manning's Formi
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	330000	ft/ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	17.56	cfs

Results		
Depth	0.33	ft
Flow Area	1.9	ft²
Wetted Perim	7.07	ft
Top Width	6.97	ft
Critical Depth	0.63	ft
Critical Slope	0.030350	ft/ft
Velocity	9.02	ft/s
Velocity Head	1.27	ft
Specific Energ	1.59	ft
Froude Numb	3.01	
Flow Type	Supercritical	

Summary for Pond P2:

Inflow Area = 37.100 ac, 0.00% Impervious, Inflow Depth = 0.43"
Inflow = 48.35 cfs @ 3.10 hrs, Volume= 1.340 af
Outflow = 14.69 cfs @ 3.25 hrs, Volume= 0.795 af, Atten= 70%, Lag= 9.5 min
Primary = 14.69 cfs @ 3.25 hrs, Volume= 0.795 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Peak Elev= 5,716.10' @ 3.25 hrs Surf.Area= 12,899 sf Storage= 25,029 cf

Plug-Flow detention time= 60.8 min calculated for 0.792 af (59% of inflow)
Center-of-Mass det. time= 27.4 min (250.6 - 223.1)

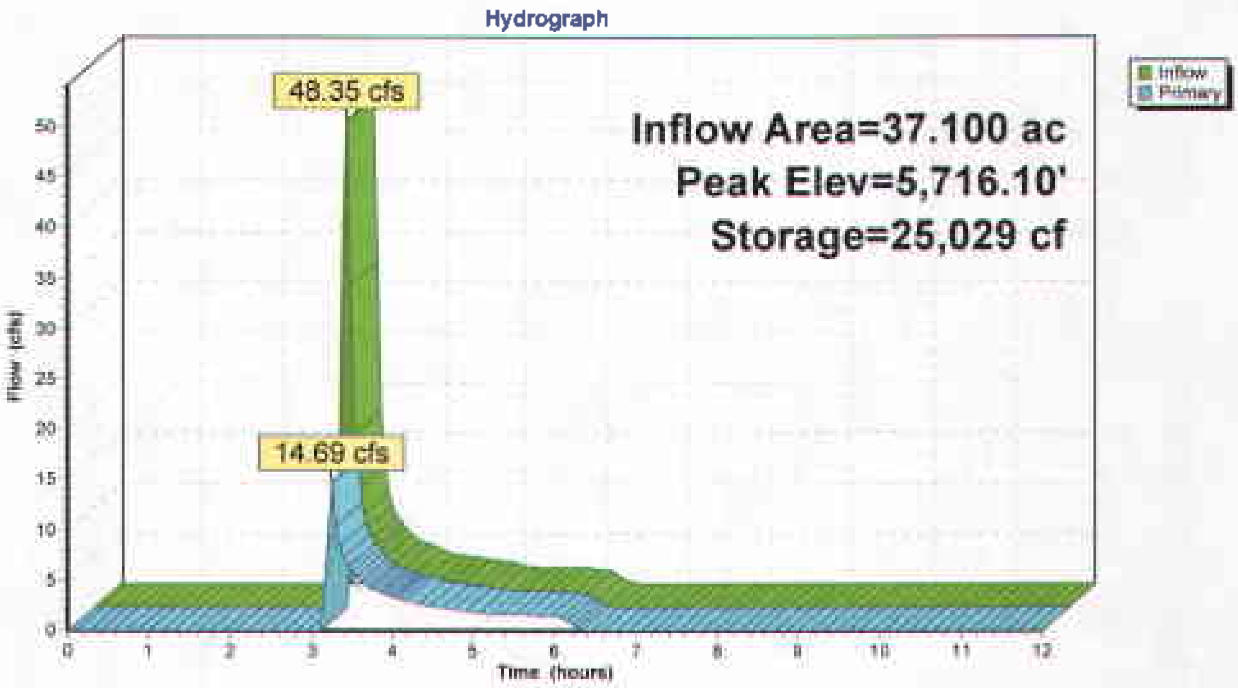
Volume	Invert	Avail.Storage	Storage Description
#1	5,704.00'	51,328 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,704.00	0	0.0	0	0
5,706.00	4,800	0.0	0	0
5,708.00	6,144	0.0	0	0
5,710.00	7,616	0.0	0	0
5,712.00	9,216	0.0	0	0
5,714.00	10,944	0.0	0	0
5,716.00	12,800	100.0	23,744	23,744
5,718.00	14,784	100.0	27,584	51,328

Device	Routing	Invert	Outlet Devices
#1	Primary	5,716.00'	**Special & User-Defined** Head (feet) 0.00 0.10 Disch. (cfs) 0.000 14.690

Primary OutFlow Max=14.32 cfs @ 3.25 hrs HW=5,716.10' (Free Discharge)
↳**1=Special & User-Defined** (Custom Controls 14.32 cfs)

Pond P2:


Hydrograph
48.35 cfs
14.69 cfs
Inflow Area=37.100 ac
Peak Elev=5,716.10'
Storage=25,029 cf
Inflow
Primary
Flow (cfs)
Time (hours)

East Pond #2 Spillway Top
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	East Pond 2 Top
Flow Element	Trapezoidal Cha
Method	Manning's Formi
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	010000	ft/ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	14.69	cfs

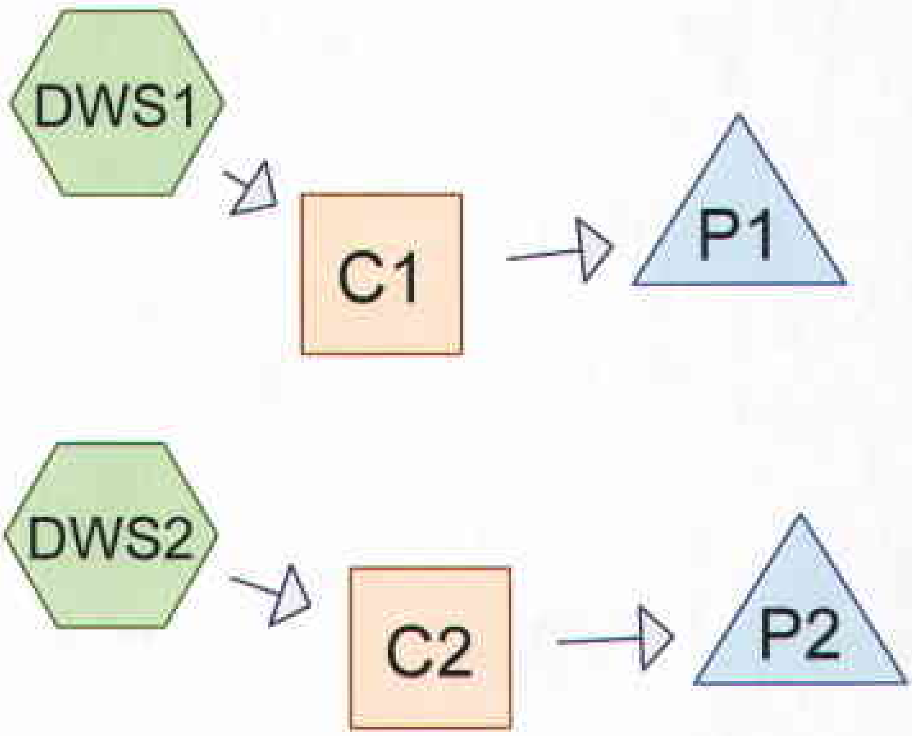
Results		
Depth	0.78	ft
Flow Area	5.7	ft²
Wetted Perim	9.96	ft
Top Width	9.71	ft
Critical Depth	0.57	ft
Critical Slope	0.031211	ft/ft
Velocity	2.57	ft/s
Velocity Head	0.10	ft
Specific Energ	0.88	ft
Froude Numb	0.59	
Flow Type	Subcritical	

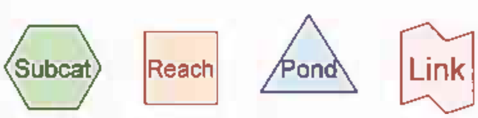
East Pond #2 Spillway Bottom
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	East Pond 2 Bot
Flow Element	Trapezoidal Cha
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	330000	ft/ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	14.69	cfs

Results		
Depth	0.29	ft
Flow Area	1.7	ft²
Wetted Perim	6.87	ft
Top Width	6.78	ft
Critical Depth	0.57	ft
Critical Slope	0.031211	ft/ft
Velocity	8.50	ft/s
Velocity Head	1.12	ft
Specific Enerç	1.42	ft
Froude Numb	2.97	
Flow Type	Supercritical	





Drainage Diagram for East Ponds 9r,6r
Prepared by EarthFax Engineering, Inc , Printed 5/13/2009

Time span=0.00-5.00 hrs, dt=0.05 hrs, 101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentDWS1: Runoff Area=14.800 ac 0.00% Impervious Runoff Depth=0.32"
Flow Length=1,680' Slope=0.5090 '/' Tc=5.5 min CN=86 Runoff=29.88 cfs 0.398 af

SubcatchmentDWS2: Runoff Area=37.100 ac 0.00% Impervious Runoff Depth=0.32"
Flow Length=1,490' Slope=0.5770 '/' Tc=4.7 min CN=86 Runoff=83.72 cfs 0.999 af

Reach C1: Avg. Depth=0.59' Max Vel=7.90 fps Inflow=29.88 cfs 0.398 af
n=0.022 L=870.0' S=0.0724 '/' Capacity=114.12 cfs Outflow=25.10 cfs 0.398 af

Reach C2: Avg. Depth=0.64' Max Vel=7.43 fps Inflow=83.72 cfs 0.999 af
n=0.022 L=640.0' S=0.0344 '/' Capacity=190.72 cfs Outflow=63.91 cfs 0.999 af

Pond P1: Peak Elev=5,672.19' Storage=17,354 cf Inflow=25.10 cfs 0.398 af
Outflow=0.00 cfs 0.000 af

Pond P2: Peak Elev=5,711.69' Storage=43,500 cf Inflow=63.91 cfs 0.999 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 51.900 ac Runoff Volume = 1.397 af Average Runoff Depth = 0.32"
100.00% Pervious = 51.900 ac 0.00% Impervious = 0.000 ac

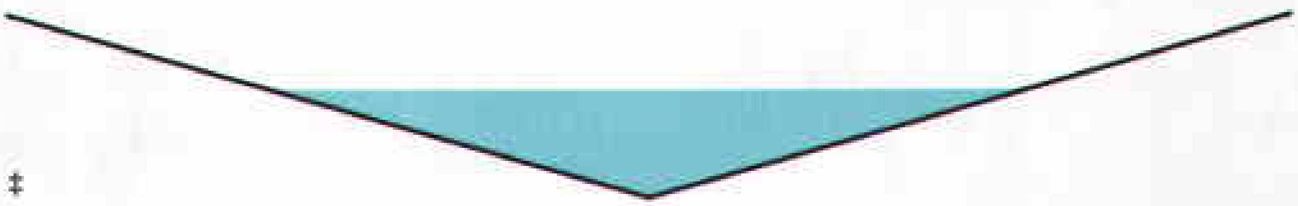
Summary for Reach C1:

Inflow Area = 14.800 ac, 0.00% Impervious, Inflow Depth = 0.32"
Inflow = 29.88 cfs @ 0.34 hrs, Volume= 0.398 af
Outflow = 25.10 cfs @ 0.41 hrs, Volume= 0.398 af, Atten= 16%, Lag= 3.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.90 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.72 fps, Avg. Travel Time= 8.5 min

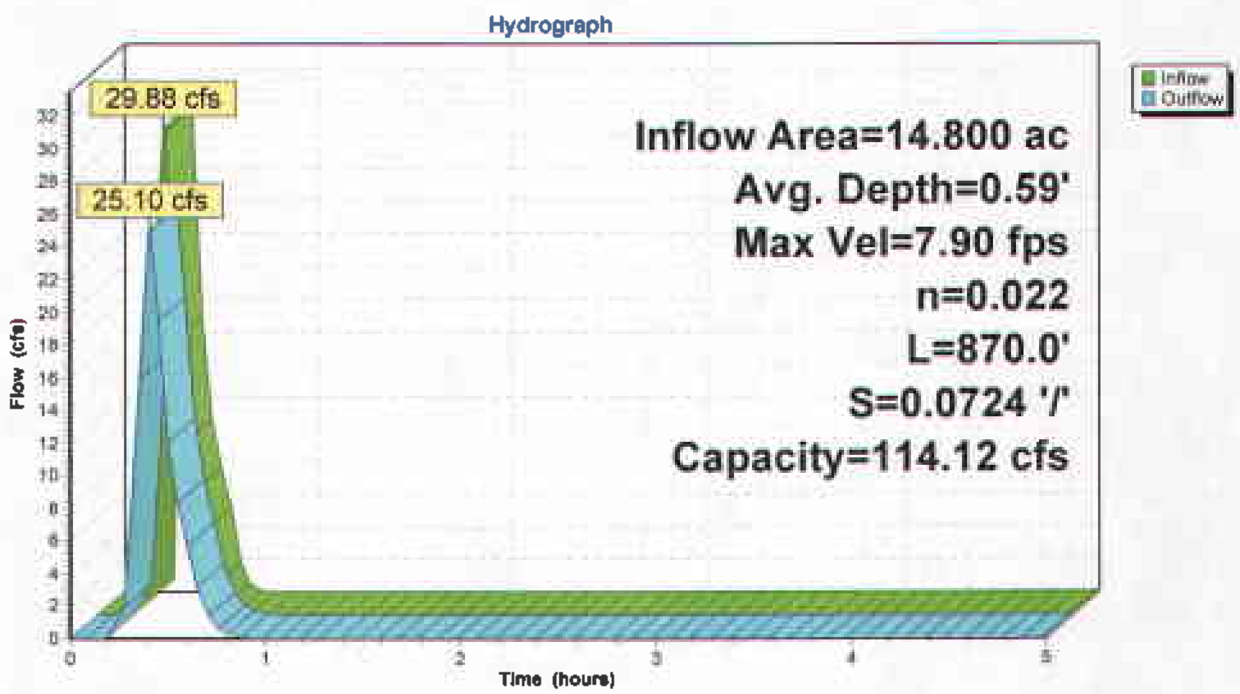
Peak Storage= 2,997 cf @ 0.37 hrs, Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 114.12 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 20.00'
Length= 870.0' Slope= 0.0724 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,677.00'



‡

Reach C1:



Summary for Reach C2:

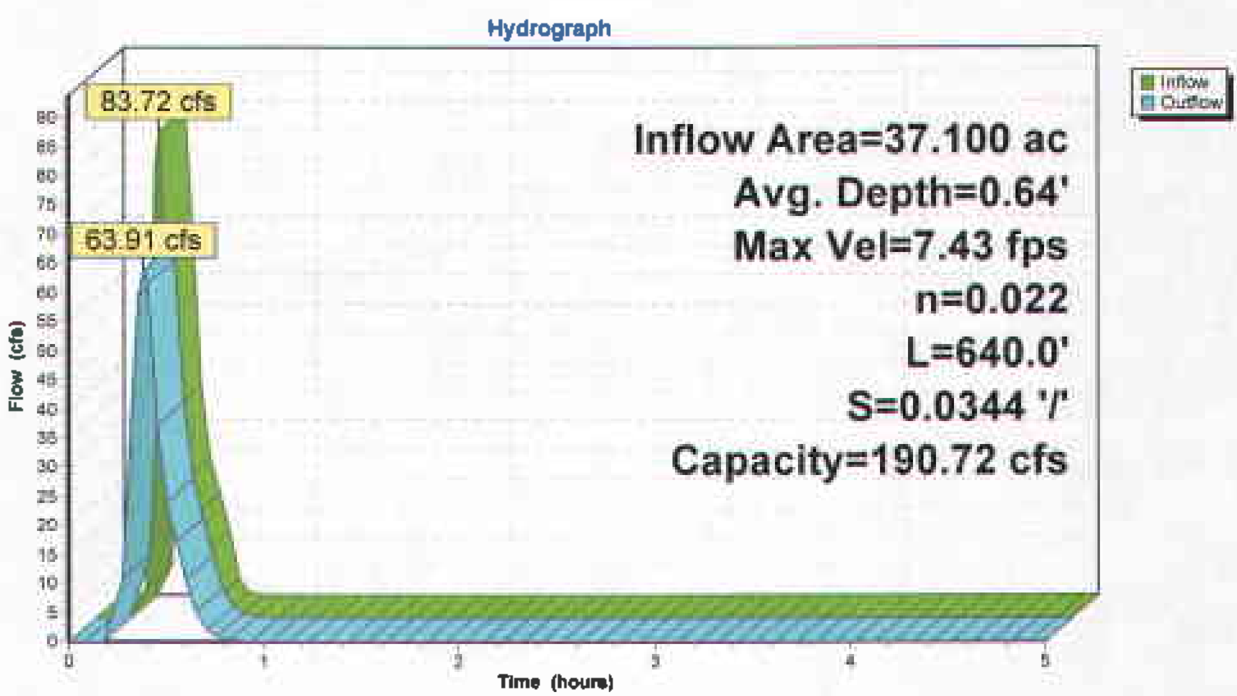
Inflow Area = 37.100 ac, 0.00% Impervious, Inflow Depth = 0.32"
Inflow = 83.72 cfs @ 0.32 hrs, Volume= 0.999 af
Outflow = 63.91 cfs @ 0.38 hrs, Volume= 0.999 af, Atten= 24%, Lag= 3.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.43 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 1.29 fps, Avg. Travel Time= 8.3 min

Peak Storage= 6,663 cf @ 0.35 hrs, Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 190.72 cfs

10.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 30.00'
Length= 640.0' Slope= 0.0344 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,718.00'

Reach C2:



Summary for Pond P1:

Inflow Area = 14.800 ac, 0.00% Impervious, Inflow Depth = 0.32"
Inflow = 25.10 cfs @ 0.41 hrs, Volume= 0.398 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

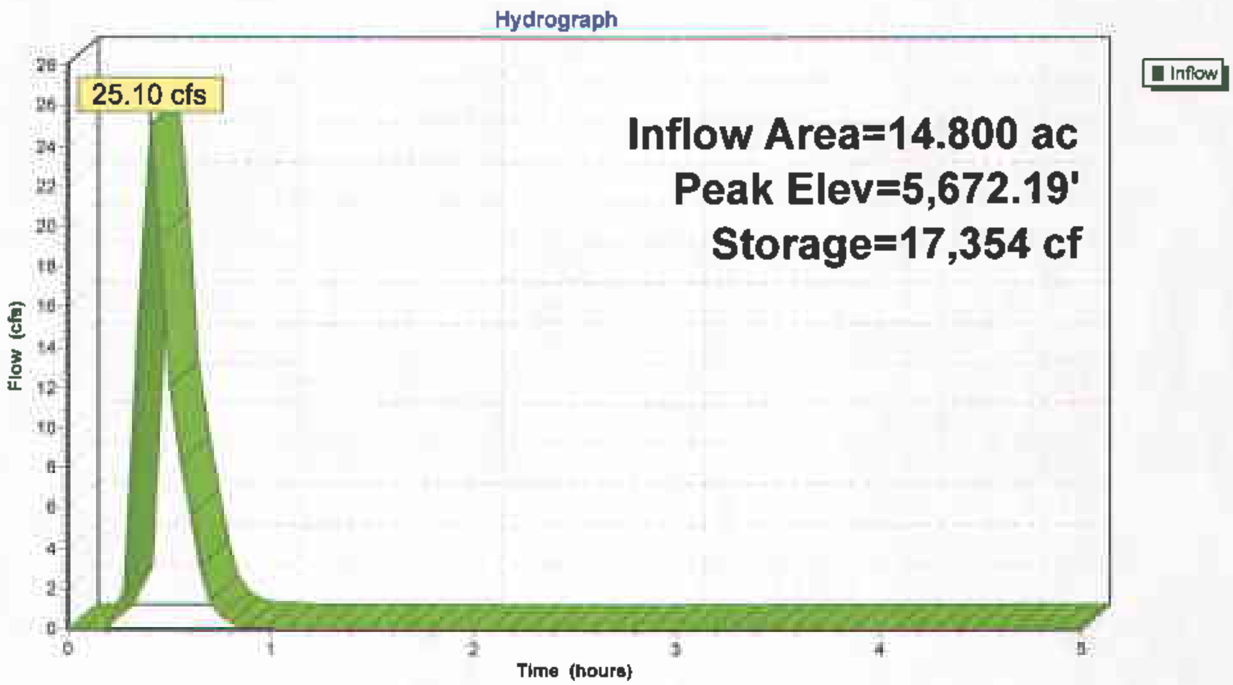
Routing by Stor-Ind method, Time Span= 0.00-5.00 hrs, dt= 0.05 hrs
Peak Elev= 5,672.19' @ 5.00 hrs Surf.Area= 0 sf Storage= 17,354 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,662.00'	44,057 cf	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (cubic-feet)
5,662.00	0
5,664.00	747
5,666.00	2,725
5,668.00	5,849
5,670.00	10,380
5,672.00	16,573
5,674.00	24,665
5,676.00	34,880
5,676.15	35,775
5,677.50	44,057

Pond P1:



Summary for Pond P2:

Inflow Area = 37.100 ac, 0.00% Impervious, Inflow Depth = 0.32"
Inflow = 63.91 cfs @ 0.38 hrs, Volume= 0.999 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

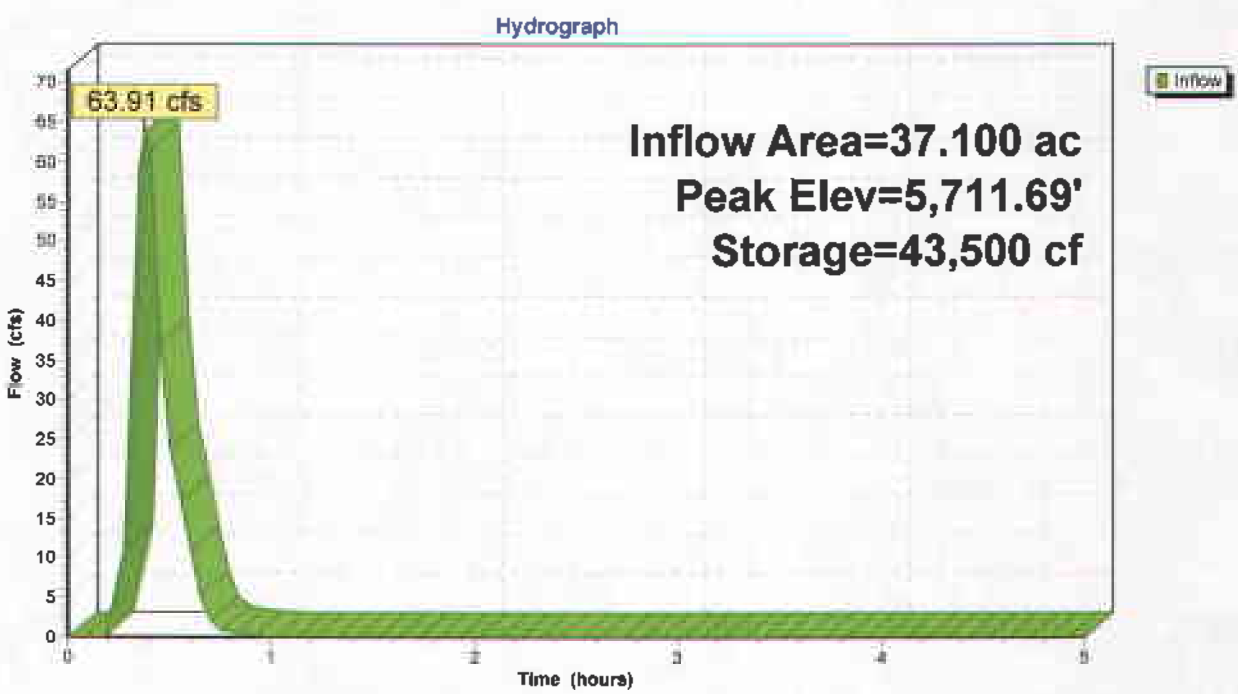
Routing by Stor-Ind method, Time Span= 0.00-5.00 hrs, dt= 0.05 hrs
Peak Elev= 5,711.69' @ 5.00 hrs Surf.Area= 8,966 sf Storage= 43,500 cf

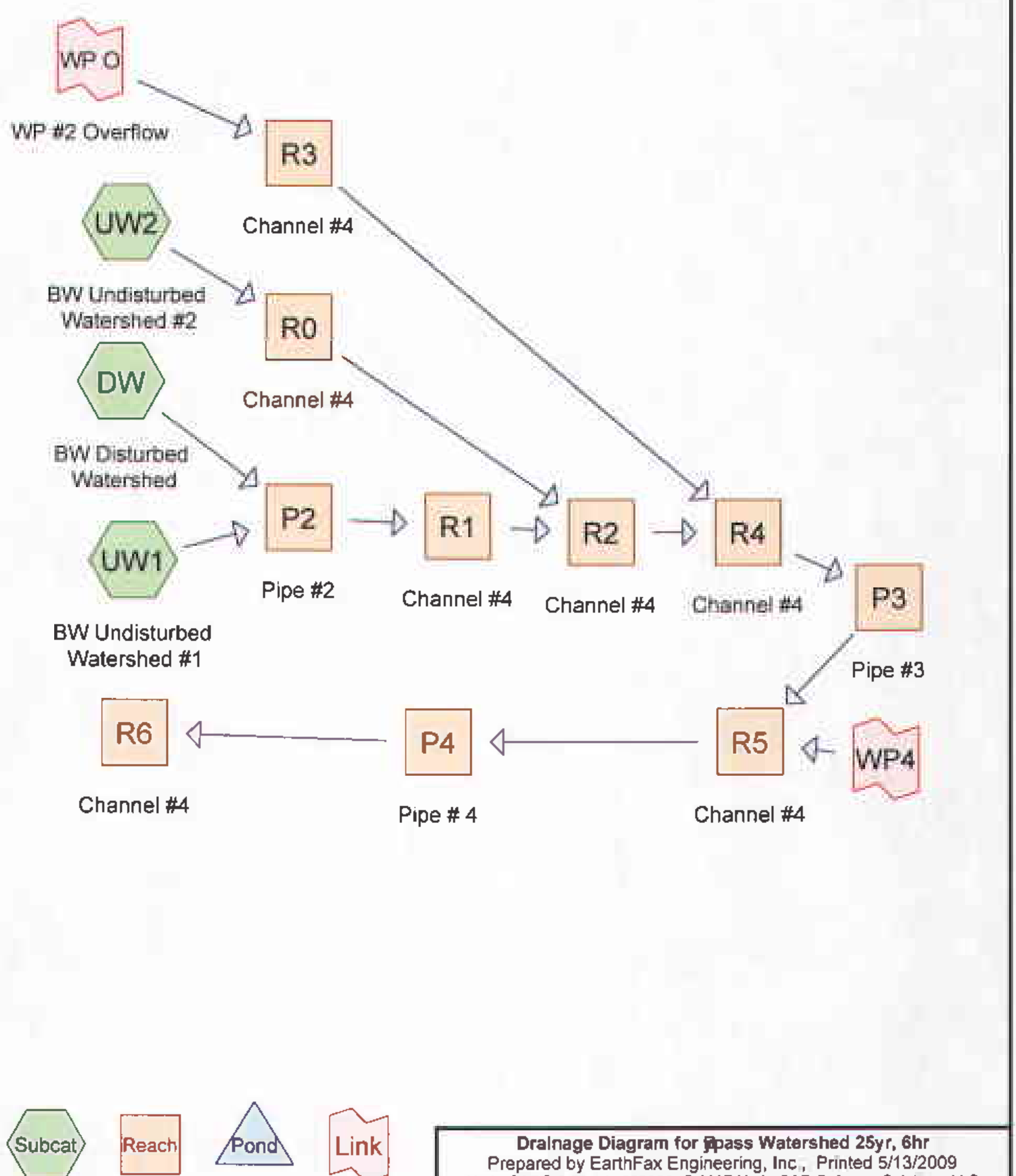
Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	5,704.00'	117,824 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,704.00	0	0	0
5,706.00	4,800	4,800	4,800
5,708.00	6,144	10,944	15,744
5,710.00	7,616	13,760	29,504
5,712.00	9,216	16,832	46,336
5,714.00	10,944	20,160	66,496
5,716.00	12,800	23,744	90,240
5,718.00	14,784	27,584	117,824

Pond P2:





Drainage Diagram for Bypass Watershed 25yr, 6hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentDW: BW Disturbed Watershed Runoff Area=1.596 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=2,322' Slope=0.1080 '/' Tc=17.8 min CN=82 Runoff=0.85 cfs 0.065 af

SubcatchmentUW1: BW Undisturbed Runoff Area=10.557 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=1,485' Slope=0.2390 '/' Tc=12.9 min CN=67 Runoff=0.36 cfs 0.090 af

SubcatchmentUW2: BW Undisturbed Runoff Area=56.124 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=3,235' Slope=0.4030 '/' Tc=18.5 min CN=67 Runoff=1.62 cfs 0.481 af

Reach P2: Pipe #2 Avg. Depth=0.22' Max Vel=9.59 fps Inflow=1.21 cfs 0.156 af
D=12.0" n=0.025 L=123.0' S=0.3984 '/' Capacity=11.69 cfs Outflow=1.20 cfs 0.156 af

Reach P3: Pipe #3 Avg. Depth=0.41' Max Vel=8.97 fps Inflow=2.76 cfs 0.947 af
D=12.0" n=0.025 L=985.0' S=0.1716 '/' Capacity=7.67 cfs Outflow=2.76 cfs 0.947 af

Reach P4: Pipe # 4 Avg. Depth=0.70' Max Vel=4.76 fps Inflow=3.34 cfs 1.068 af
D=15.0" n=0.025 L=36.0' S=0.0278 '/' Capacity=5.60 cfs Outflow=3.34 cfs 1.068 af

Reach R0: Channel #4 Avg. Depth=0.36' Max Vel=5.67 fps Inflow=1.62 cfs 0.481 af
n=0.050 L=2,465.0' S=0.4199 '/' Capacity=22.52 cfs Outflow=1.44 cfs 0.481 af

Reach R1: Channel #4 Avg. Depth=0.32' Max Vel=5.78 fps Inflow=1.20 cfs 0.156 af
n=0.050 L=945.0' S=0.5185 '/' Capacity=25.03 cfs Outflow=1.15 cfs 0.156 af

Reach R2: Channel #4 Avg. Depth=0.44' Max Vel=5.30 fps Inflow=2.03 cfs 0.637 af
n=0.050 L=384.0' S=0.2813 '/' Capacity=18.43 cfs Outflow=2.02 cfs 0.637 af

Reach R3: Channel #4 Avg. Depth=0.43' Max Vel=7.51 fps Inflow=2.76 cfs 0.310 af
n=0.050 L=725.0' S=0.5779 '/' Capacity=26.43 cfs Outflow=2.76 cfs 0.310 af

Reach R4: Channel #4 Avg. Depth=0.46' Max Vel=6.64 fps Inflow=2.76 cfs 0.947 af
n=0.050 L=382.0' S=0.4162 '/' Capacity=22.43 cfs Outflow=2.76 cfs 0.947 af

Reach R5: Channel #4 Avg. Depth=0.53' Max Vel=6.06 fps Inflow=3.37 cfs 1.068 af
n=0.040 L=218.0' S=0.1835 '/' Capacity=24.00 cfs Outflow=3.34 cfs 1.068 af

Reach R6: Channel #4 Avg. Depth=0.47' Max Vel=7.58 fps Inflow=3.34 cfs 1.068 af
n=0.040 L=21.0' S=0.3333 '/' Capacity=25.09 cfs Outflow=3.34 cfs 1.068 af

Link WP O: Primary Outflow Imported from West Pond #2 25yr, 6hrPond WP2.hce Inflow=2.76 cfs 0.310 af
Area= 17.688 ac Primary=2.76 cfs 0.310 af

Link WP4: Primary Outflow Imported from West Pond #4 25yr, 6hrPond 1P.hce Inflow=2.10 cfs 0.121 af
Area= 9.188 ac Primary=2.10 cfs 0.121 af

Total Runoff Area = 68.277 ac Runoff Volume = 0.637 af Average Runoff Depth = 0.11"
100.00% Pervious = 68.277 ac 0.00% Impervious = 0.000 ac

Summary for Reach P2: Pipe #2

[52] Hint: Inlet/Outlet conditions not evaluated

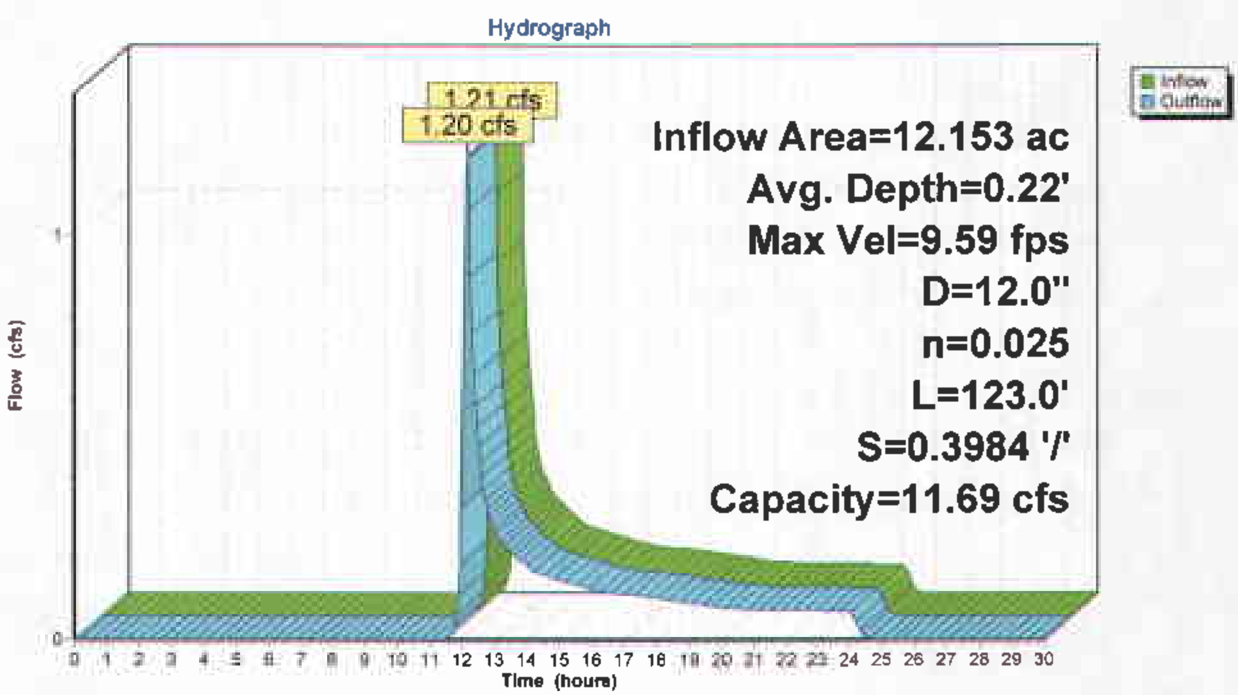
Inflow Area = 12.153 ac, 0.00% Impervious, Inflow Depth = 0.15"
Inflow = 1.21 cfs @ 12.13 hrs, Volume= 0.156 af
Outflow = 1.20 cfs @ 12.14 hrs, Volume= 0.156 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.59 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 4.66 fps, Avg. Travel Time= 0.4 min

Peak Storage= 15 cf @ 12.13 hrs, Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 11.69 cfs

12.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 123.0' Slope= 0.3984 '/'
Inlet Invert= 6,550.00', Outlet Invert= 6,501.00'

Reach P2: Pipe #2



Summary for Reach P3: Pipe #3

[52] Hint: Inlet/Outlet conditions not evaluated

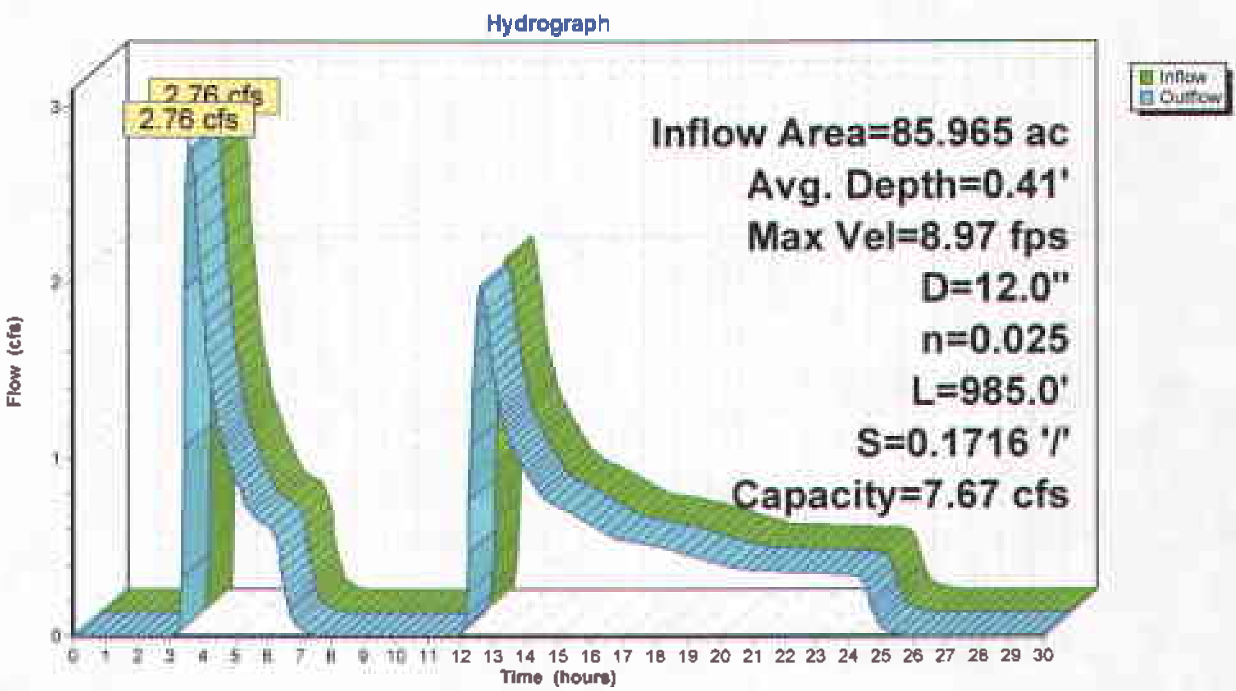
Inflow Area = 85.965 ac, 0.00% Impervious, Inflow Depth = 0.13"
Inflow = 2.76 cfs @ 3.55 hrs, Volume= 0.947 af
Outflow = 2.76 cfs @ 3.61 hrs, Volume= 0.947 af, Atten= 0%, Lag= 3.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.97 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 4.51 fps, Avg. Travel Time= 3.6 min

Peak Storage= 303 cf @ 3.57 hrs, Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 7.67 cfs

12.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 985.0' Slope= 0.1716 '/'
Inlet Invert= 5,739.00', Outlet Invert= 5,570.00'

Reach P3: Pipe #3



Summary for Reach P4: Pipe # 4

[52] Hint: Inlet/Outlet conditions not evaluated

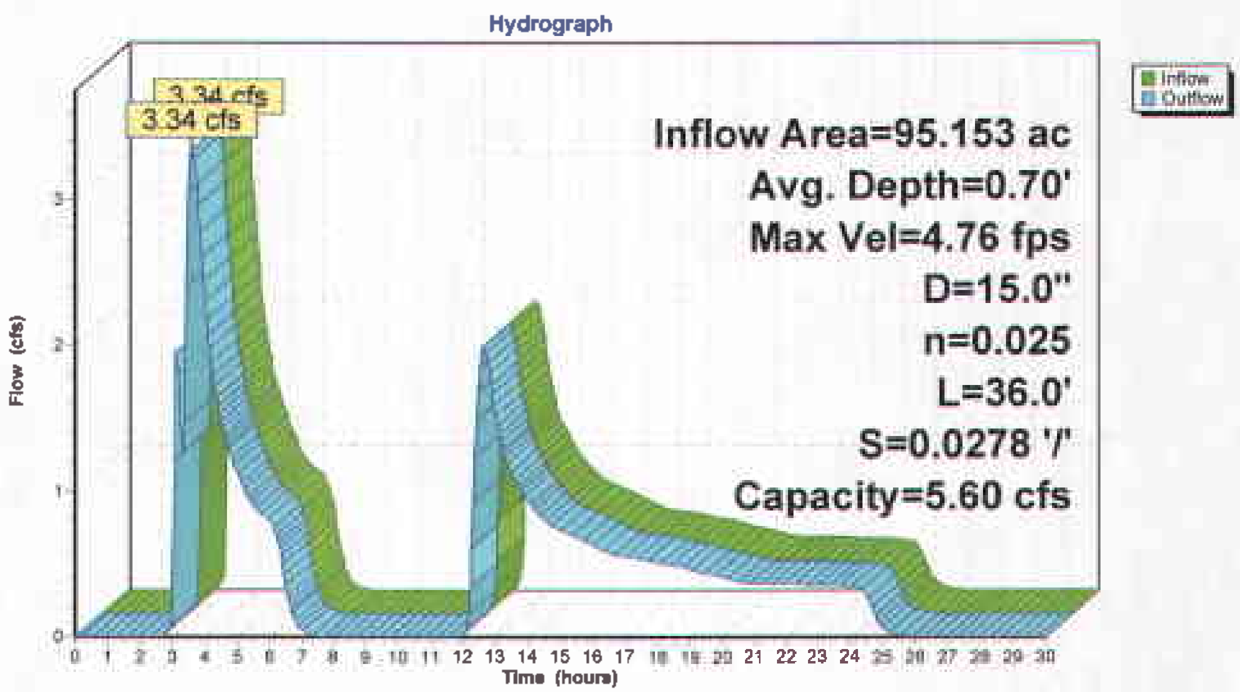
Inflow Area = 95.153 ac, 0.00% Impervious, Inflow Depth = 0.13"
Inflow = 3.34 cfs @ 3.59 hrs, Volume= 1.068 af
Outflow = 3.34 cfs @ 3.60 hrs, Volume= 1.068 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.76 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.24 fps, Avg. Travel Time= 0.3 min

Peak Storage= 25 cf @ 3.59 hrs, Average Depth at Peak Storage= 0.70'
Bank-Full Depth= 1.25', Capacity at Bank-Full= 5.60 cfs

15.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 36.0' Slope= 0.0278 '/'
Inlet Invert= 5,539.00', Outlet Invert= 5,538.00'

Reach P4: Pipe # 4



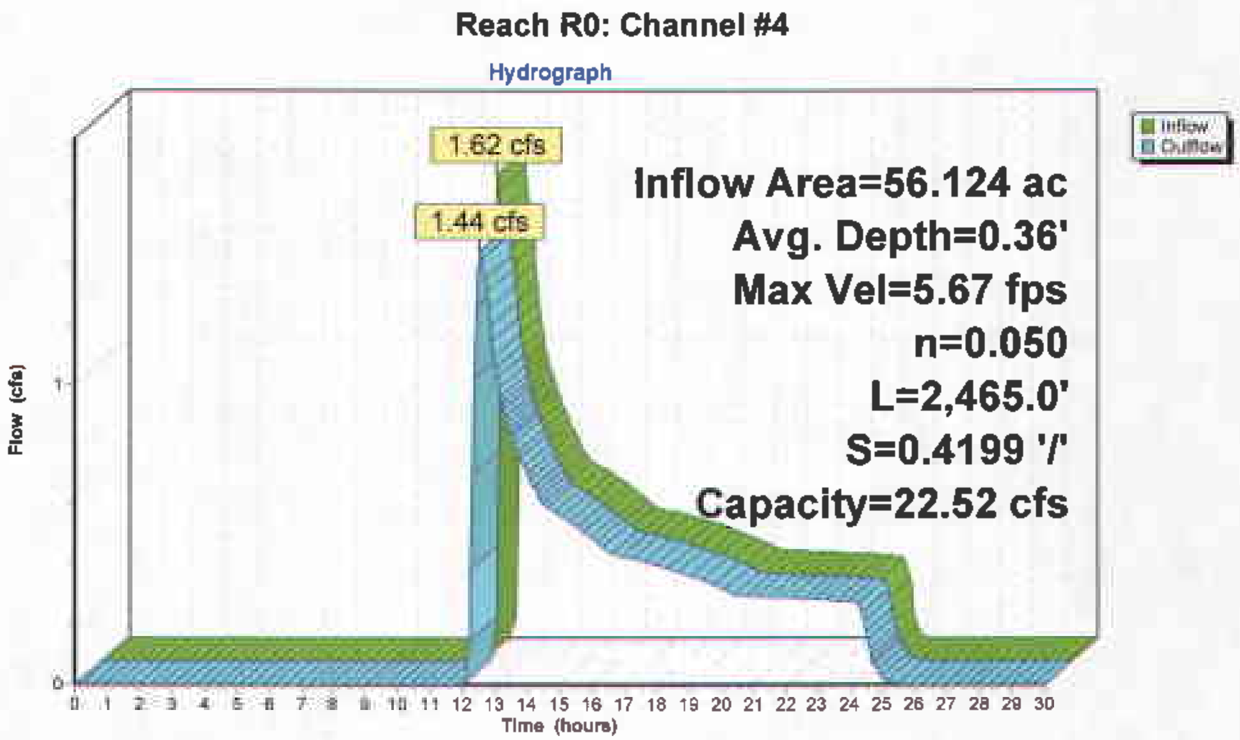
Summary for Reach R0: Channel #4

Inflow Area = 56.124 ac, 0.00% Impervious, Inflow Depth = 0.10"
Inflow = 1.62 cfs @ 12.25 hrs, Volume= 0.481 af
Outflow = 1.44 cfs @ 12.54 hrs, Volume= 0.481 af, Atten= 11%, Lag= 17.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.67 fps, Min. Travel Time= 7.2 min
Avg. Velocity = 3.39 fps, Avg. Travel Time= 12.1 min

Peak Storage= 629 cf @ 12.42 hrs, Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 22.52 cfs

0.00' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 2,465.0' Slope= 0.4199 '/'
Inlet Invert= 7,045.00', Outlet Invert= 6,010.00'



Summary for Reach R1: Channel #4

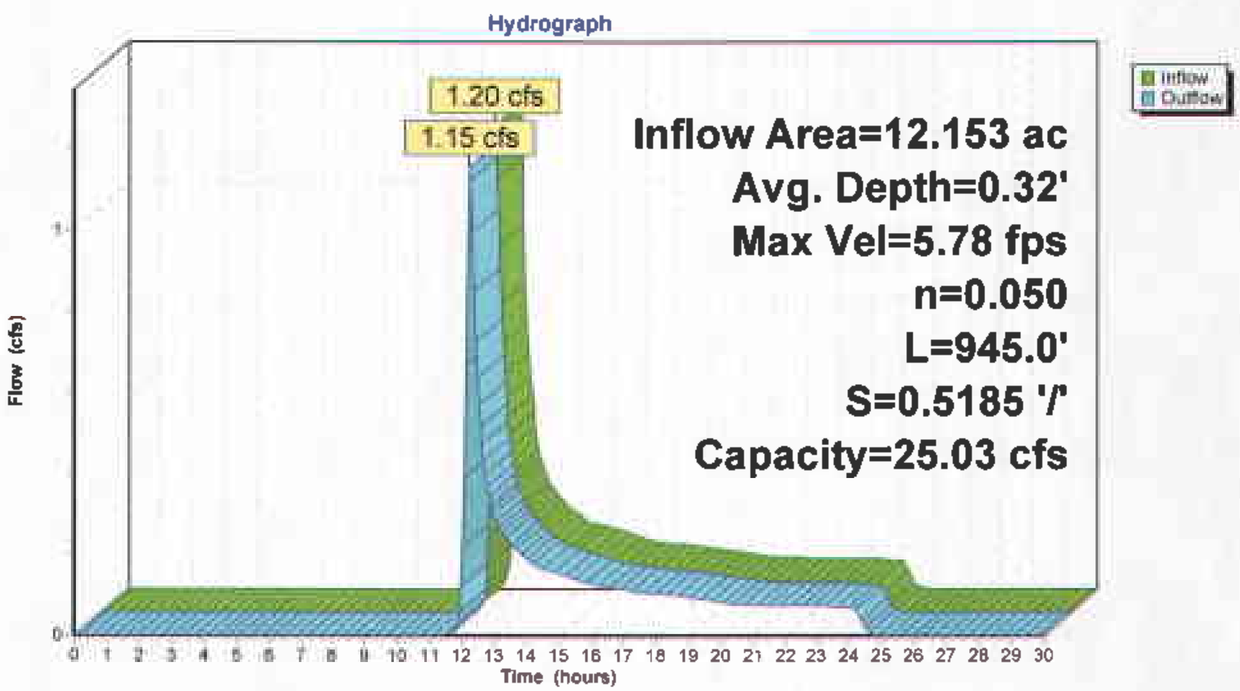
Inflow Area =	12.153 ac,	0.00% Impervious, Inflow Depth = 0.15"	
Inflow =	1.20 cfs @	12.14 hrs, Volume=	0.156 af
Outflow =	1.15 cfs @	12.22 hrs, Volume=	0.156 af, Atten= 4%, Lag= 5.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.78 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 3.04 fps, Avg. Travel Time= 5.2 min

Peak Storage= 189 cf @ 12.17 hrs, Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 25.03 cfs

0.00' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 945.0' Slope= 0.5185 '/'
Inlet Invert= 6,500.00', Outlet Invert= 6,010.00'

Reach R1: Channel #4



Summary for Reach R2: Channel #4

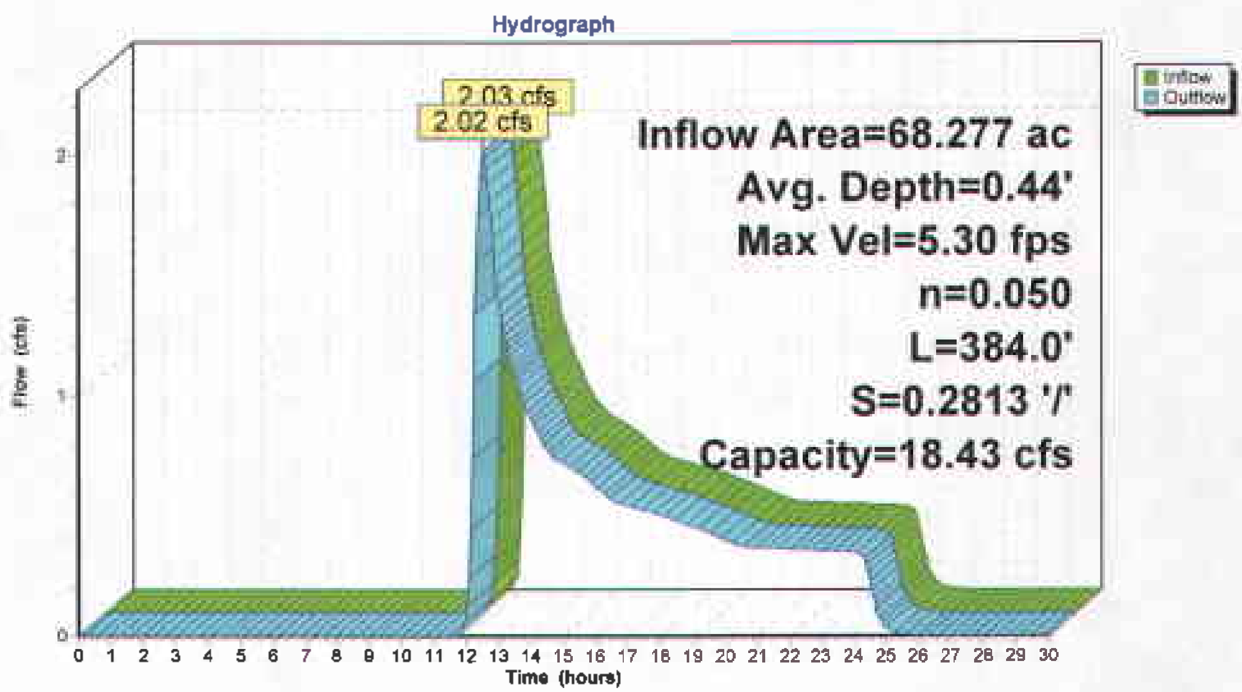
Inflow Area = 68.277 ac, 0.00% Impervious, Inflow Depth = 0.11"
Inflow = 2.03 cfs @ 12.46 hrs, Volume= 0.637 af
Outflow = 2.02 cfs @ 12.50 hrs, Volume= 0.637 af, Atten= 0%, Lag= 2.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.30 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 2.99 fps, Avg. Travel Time= 2.1 min

Peak Storage= 147 cf @ 12.47 hrs, Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 18.43 cfs

0.00' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 384.0' Slope= 0.2813 '/'
Inlet Invert= 6,009.00', Outlet Invert= 5,901.00'

Reach R2: Channel #4



Summary for Reach R3: Channel #4

[88] Warning: Qut@ may require Finer Routing>

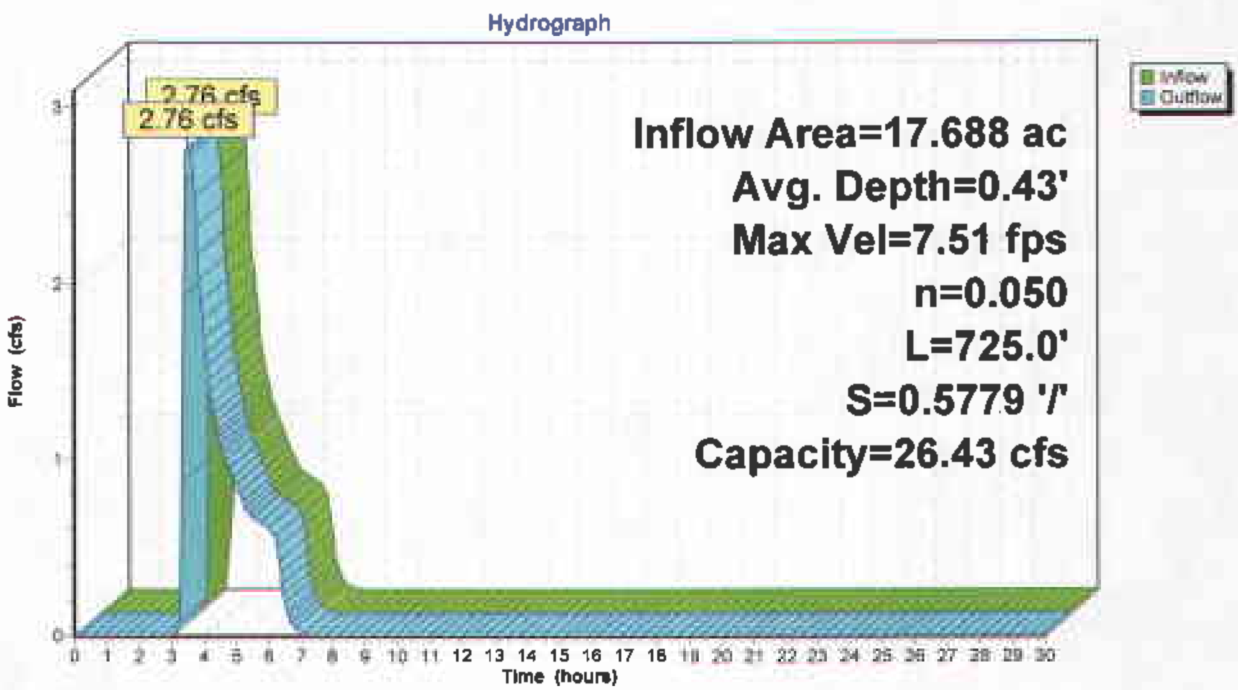
Inflow Area = 17.688 ac, 0.00% Impervious, Inflow Depth = 0.21"
Inflow = 2.76 cfs @ 3.40 hrs, Volume= 0.310 af
Outflow = 2.76 cfs @ 3.52 hrs, Volume= 0.310 af, Atten= 0%, Lag= 7.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.51 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 4.28 fps, Avg. Travel Time= 2.8 min

Peak Storage= 267 cf @ 3.45 hrs, Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 26.43 cfs

0.00' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 725.0' Slope= 0.5779 '/'
Inlet Invert= 6,319.00', Outlet Invert= 5,900.00'

Reach R3: Channel #4



Summary for Reach R4: Channel #4

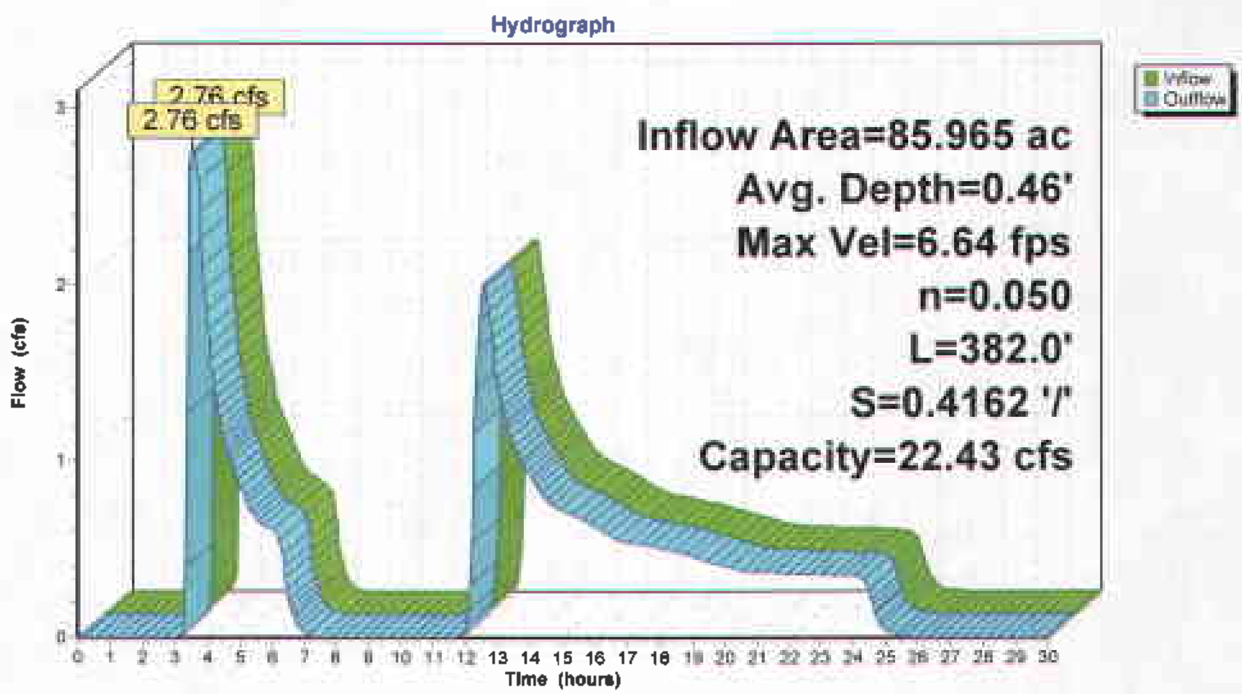
Inflow Area = 85.965 ac, 0.00% Impervious, Inflow Depth = 0.13"
Inflow = 2.76 cfs @ 3.52 hrs, Volume= 0.947 af
Outflow = 2.76 cfs @ 3.55 hrs, Volume= 0.947 af, Atten= 0%, Lag= 1.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.64 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 3.52 fps, Avg. Travel Time= 1.8 min

Peak Storage= 159 cf @ 3.50 hrs, Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 22.43 cfs

0.00' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 382.0' Slope= 0.4162 '/'
Inlet Invert= 5,899.00', Outlet Invert= 5,740.00'

Reach R4: Channel #4



Summary for Reach R5: Channel #4

[62] Warning: Exceeded Reach P3 OUTLET depth by 10.44' @ 3.10 hrs

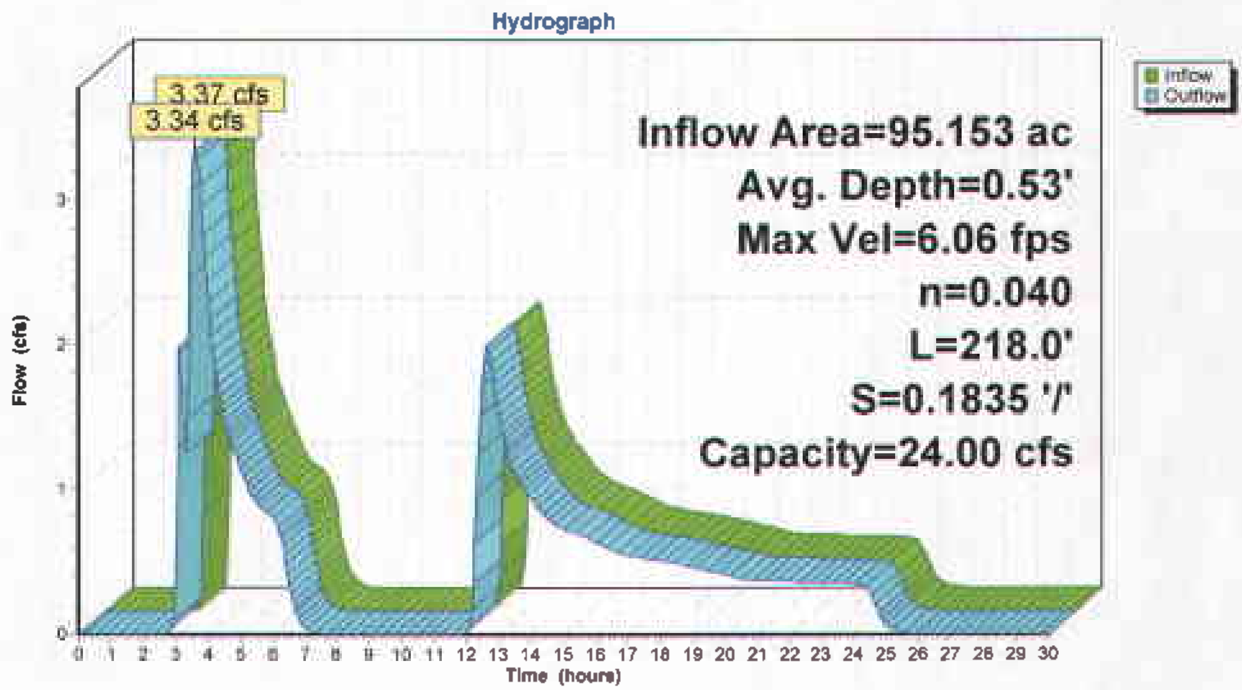
Inflow Area = 95.153 ac, 0.00% Impervious, Inflow Depth = 0.13"
Inflow = 3.37 cfs @ 3.57 hrs, Volume= 1.068 af
Outflow = 3.34 cfs @ 3.59 hrs, Volume= 1.068 af, Atten= 1%, Lag= 1.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.06 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 3.01 fps, Avg. Travel Time= 1.2 min

Peak Storage= 121 cf @ 3.57 hrs, Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 1.10', Capacity at Bank-Full= 24.00 cfs

0.00' x 1.10' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 4.40'
Length= 218.0' Slope= 0.1835 '/'
Inlet Invert= 5,580.00', Outlet Invert= 5,540.00'

Reach R5: Channel #4



Summary for Reach R6: Channel #4

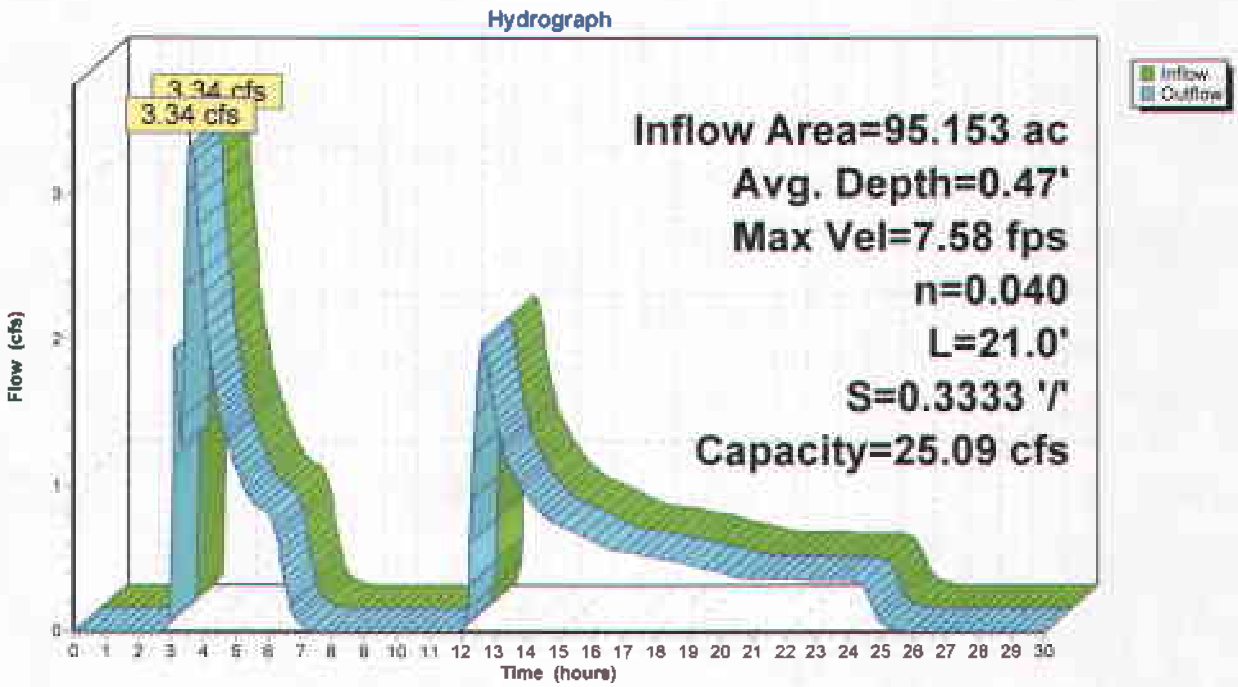
Inflow Area = 95.153 ac, 0.00% Impervious, Inflow Depth = 0.13"
Inflow = 3.34 cfs @ 3.60 hrs, Volume= 1.068 af
Outflow = 3.34 cfs @ 3.60 hrs, Volume= 1.068 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.58 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.81 fps, Avg. Travel Time= 0.1 min

Peak Storage= 9 cf @ 3.60 hrs, Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 25.09 cfs

0.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 21.0' Slope= 0.3333 '/'
Inlet Invert= 5,537.00', Outlet Invert= 5,530.00'

Reach R6: Channel #4



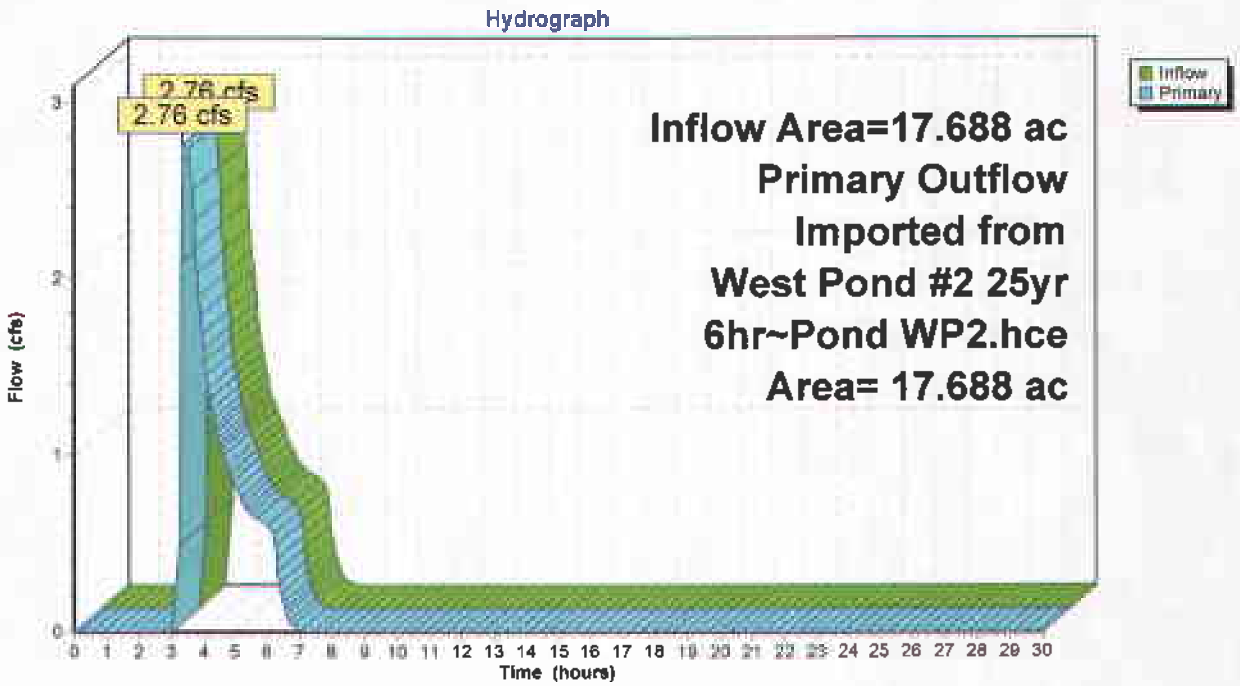
Summary for Link WP O: WP #2 Overflow

Inflow Area =	17.688 ac,	0.00% Impervious,	Inflow Depth =	0.21"	
Inflow =	2.76 cfs @	3.40 hrs,	Volume=	0.310 af	
Primary =	2.76 cfs @	3.40 hrs,	Volume=	0.310 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Primary Outflow Imported from West Pond #2 25yr, 6hrPond WP2.hce

Link WP O: WP #2 Overflow



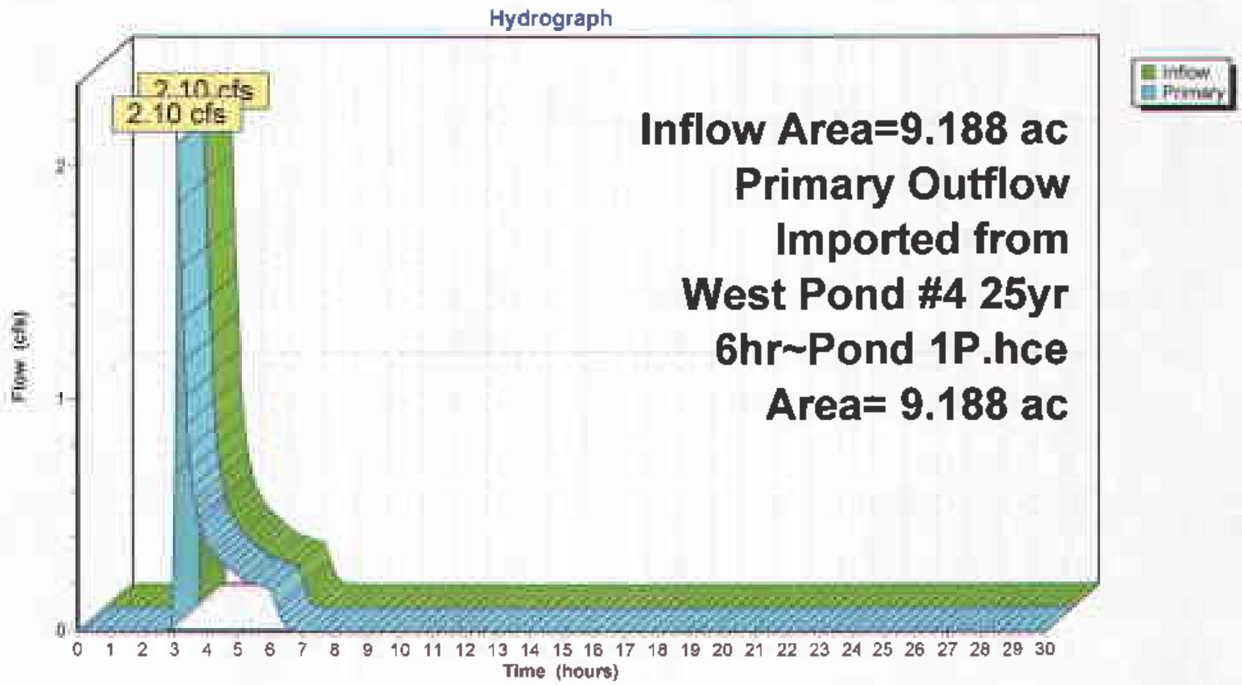
Summary for Link WP4:

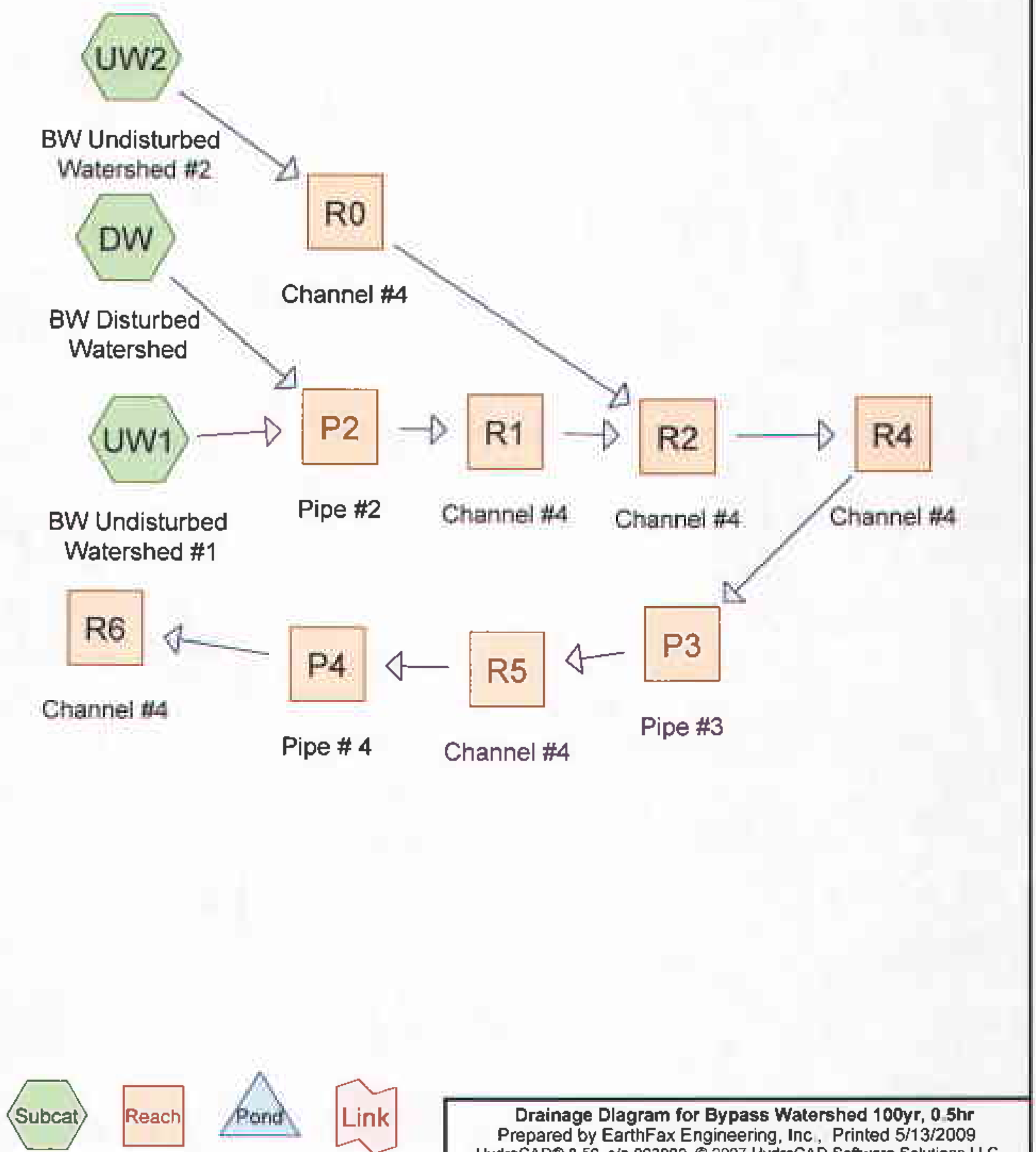
Inflow Area =	9.188 ac,	0.00% Impervious,	Inflow Depth =	0.16"
Inflow =	2.10 cfs @	3.10 hrs, Volume=	0.121 af	
Primary =	2.10 cfs @	3.10 hrs, Volume=	0.121 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Primary Outflow Imported from West Pond #4 25yr, 6hrPond 1P.hce

Link WP4:





Drainage Diagram for Bypass Watershed 100yr, 0.5hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-5.00 hrs, dt=0.01 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW: BW Disturbed Watershed Runoff Area=1.596 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=2,322' Slope=0.1080 '/' Tc=17.8 min CN=82 Runoff=1.01 cfs 0.028 af

Subcatchment UW1: BW Undisturbed Runoff Area=10.557 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=1,485' Slope=0.2390 '/' Tc=12.9 min CN=67 Runoff=0.48 cfs 0.010 af

Subcatchment UW2: BW Undisturbed Runoff Area=56.124 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=3,235' Slope=0.4030 '/' Tc=18.5 min CN=67 Runoff=2.06 cfs 0.054 af

Reach P2: Pipe #2 Avg. Depth=0.24' Max Vel=10.15 fps Inflow=1.46 cfs 0.038 af
D=12.0" n=0.025 L=123.0' S=0.3984 '/' Capacity=11.69 cfs Outflow=1.46 cfs 0.038 af

Reach P3: Pipe #3 Avg. Depth=0.37' Max Vel=8.49 fps Inflow=2.27 cfs 0.092 af
D=12.0" n=0.025 L=985.0' S=0.1716 '/' Capacity=7.67 cfs Outflow=2.25 cfs 0.092 af

Reach P4: Pipe # 4 Avg. Depth=0.55' Max Vel=4.31 fps Inflow=2.25 cfs 0.092 af
D=15.0" n=0.025 L=36.0' S=0.0278 '/' Capacity=5.60 cfs Outflow=2.25 cfs 0.092 af

Reach R0: Channel #4 Avg. Depth=0.38' Max Vel=5.87 fps Inflow=2.06 cfs 0.054 af
n=0.050 L=2,465.0' S=0.4199 '/' Capacity=22.52 cfs Outflow=1.66 cfs 0.054 af

Reach R1: Channel #4 Avg. Depth=0.34' Max Vel=6.09 fps Inflow=1.46 cfs 0.038 af
n=0.050 L=945.0' S=0.5185 '/' Capacity=25.03 cfs Outflow=1.41 cfs 0.038 af

Reach R2: Channel #4 Avg. Depth=0.46' Max Vel=5.47 fps Inflow=2.29 cfs 0.092 af
n=0.050 L=384.0' S=0.2813 '/' Capacity=18.43 cfs Outflow=2.28 cfs 0.092 af

Reach R4: Channel #4 Avg. Depth=0.42' Max Vel=6.33 fps Inflow=2.28 cfs 0.092 af
n=0.050 L=382.0' S=0.4162 '/' Capacity=22.43 cfs Outflow=2.27 cfs 0.092 af

Reach R5: Channel #4 Avg. Depth=0.45' Max Vel=5.49 fps Inflow=2.25 cfs 0.092 af
n=0.040 L=218.0' S=0.1835 '/' Capacity=24.00 cfs Outflow=2.25 cfs 0.092 af

Reach R6: Channel #4 Avg. Depth=0.40' Max Vel=6.86 fps Inflow=2.25 cfs 0.092 af
n=0.040 L=21.0' S=0.3333 '/' Capacity=25.09 cfs Outflow=2.25 cfs 0.092 af

Total Runoff Area = 68.277 ac Runoff Volume = 0.092 af Average Runoff Depth = 0.02"
100.00% Pervious = 68.277 ac 0.00% Impervious = 0.000 ac

Summary for Reach P2: Pipe #2

[52] Hint: Inlet/Outlet conditions not evaluated

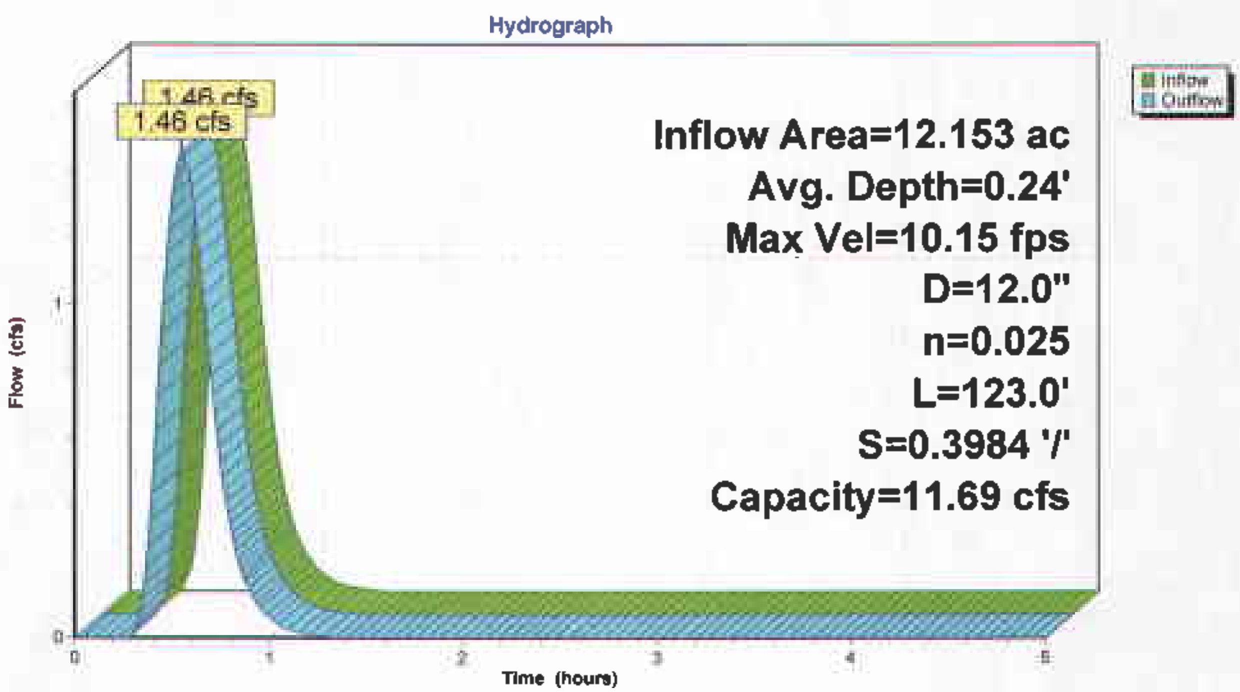
Inflow Area = 12.153 ac, 0.00% Impervious, Inflow Depth = 0.04"
Inflow = 1.46 cfs @ 0.55 hrs, Volume= 0.038 af
Outflow = 1.46 cfs @ 0.55 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.15 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 5.12 fps, Avg. Travel Time= 0.4 min

Peak Storage= 18 cf @ 0.55 hrs, Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 11.69 cfs

12.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 123.0' Slope= 0.3984 '/'
Inlet Invert= 6,550.00', Outlet Invert= 6,501.00'

Reach P2: Pipe #2



Summary for Reach P3: Pipe #3

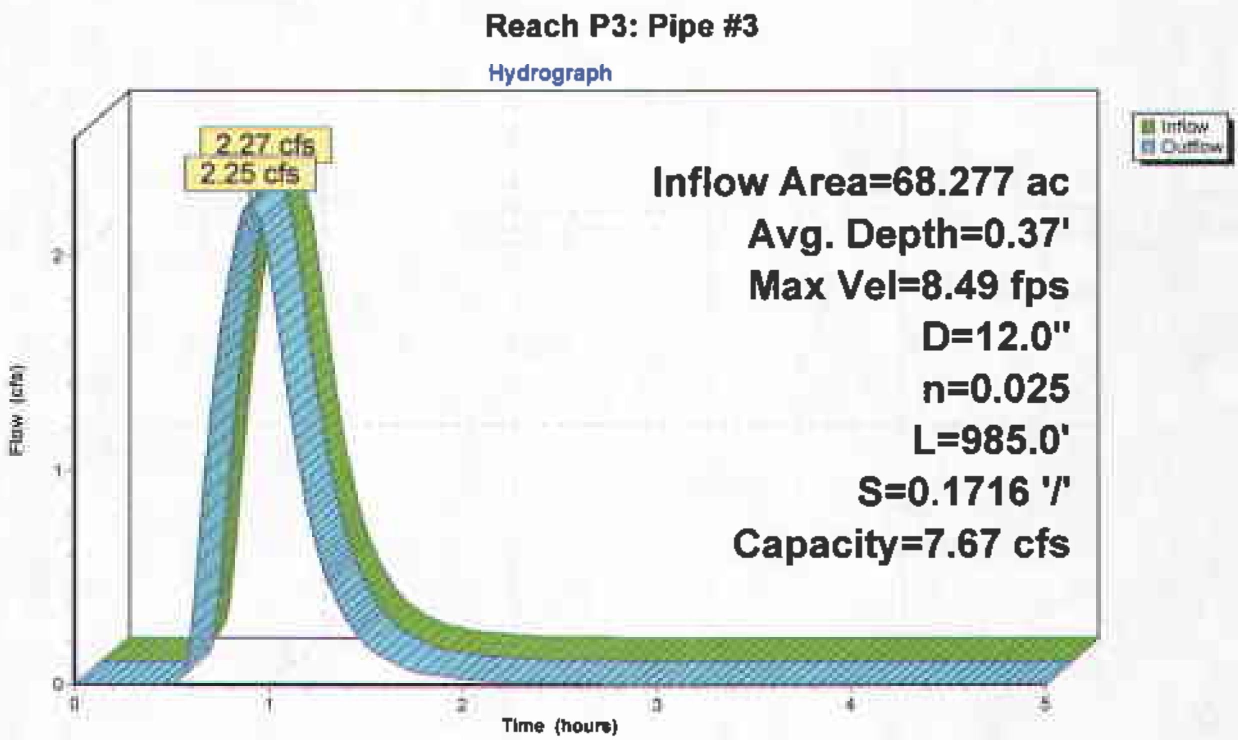
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 68.277 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 2.27 cfs @ 0.85 hrs, Volume= 0.092 af
Outflow = 2.25 cfs @ 0.90 hrs, Volume= 0.092 af, Atten= 1%, Lag= 3.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.49 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 2.46 fps, Avg. Travel Time= 6.7 min

Peak Storage= 261 cf @ 0.87 hrs, Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 7.67 cfs

12.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 985.0' Slope= 0.1716 '/'
Inlet Invert= 5,739.00', Outlet Invert= 5,570.00'



Summary for Reach P4: Pipe # 4

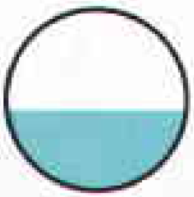
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 68.277 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 2.25 cfs @ 0.92 hrs, Volume= 0.092 af
Outflow = 2.25 cfs @ 0.93 hrs, Volume= 0.092 af, Atten= 0%, Lag= 0.2 min

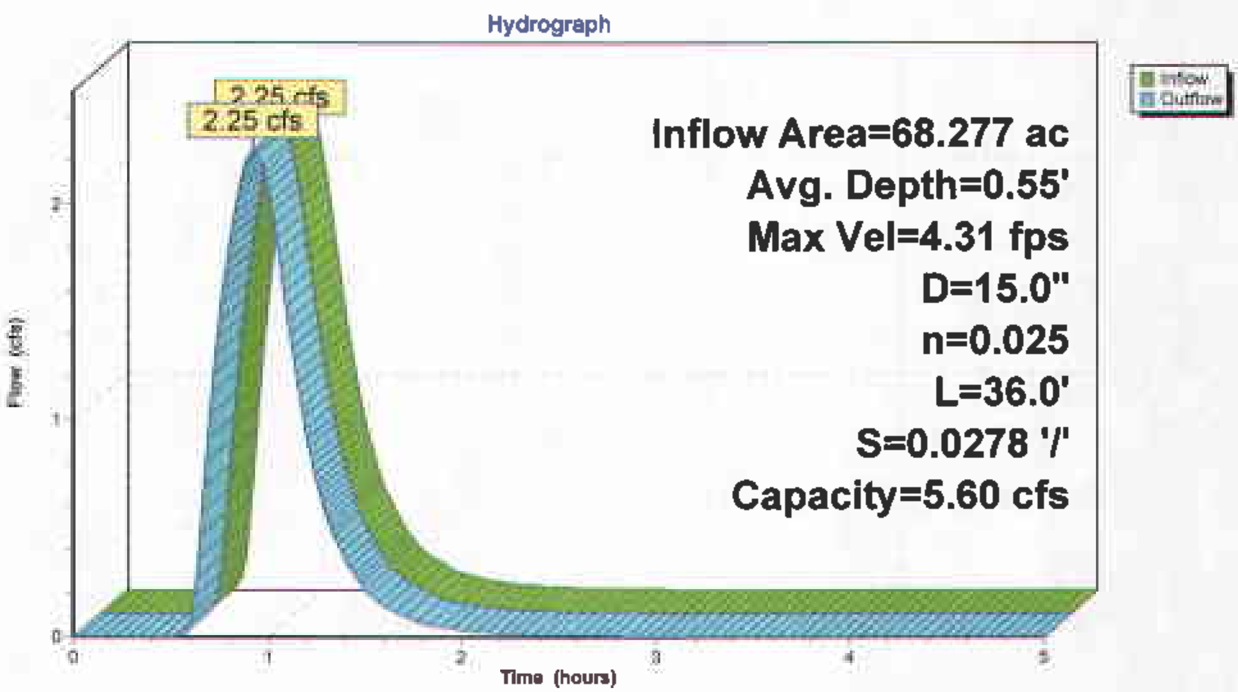
Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.31 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.27 fps, Avg. Travel Time= 0.5 min

Peak Storage= 19 cf @ 0.92 hrs, Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.25', Capacity at Bank-Full= 5.60 cfs

15.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 36.0' Slope= 0.0278 '/'
Inlet Invert= 5,539.00', Outlet Invert= 5,538.00'



Reach P4: Pipe # 4



Summary for Reach R0: Channel #4

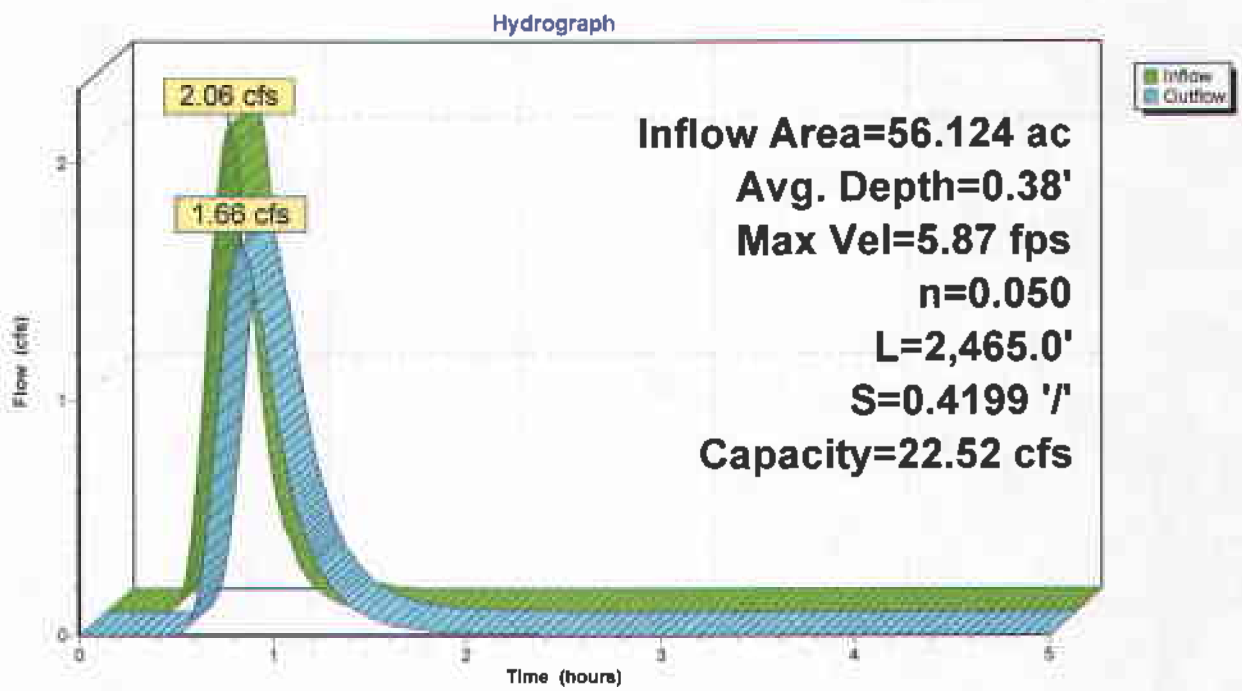
Inflow Area = 56.124 ac, 0.00% Impervious, Inflow Depth = 0.01"
Inflow = 2.06 cfs @ 0.64 hrs, Volume= 0.054 af
Outflow = 1.66 cfs @ 0.84 hrs, Volume= 0.054 af, Atten= 20%, Lag= 11.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.87 fps, Min. Travel Time= 7.0 min
Avg. Velocity = 1.70 fps, Avg. Travel Time= 24.2 min

Peak Storage= 698 cf @ 0.72 hrs, Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 22.52 cfs

0.00' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 2,465.0' Slope= 0.4199 '/'
Inlet Invert= 7,045.00', Outlet Invert= 6,010.00'

Reach R0: Channel #4



Summary for Reach R1: Channel #4

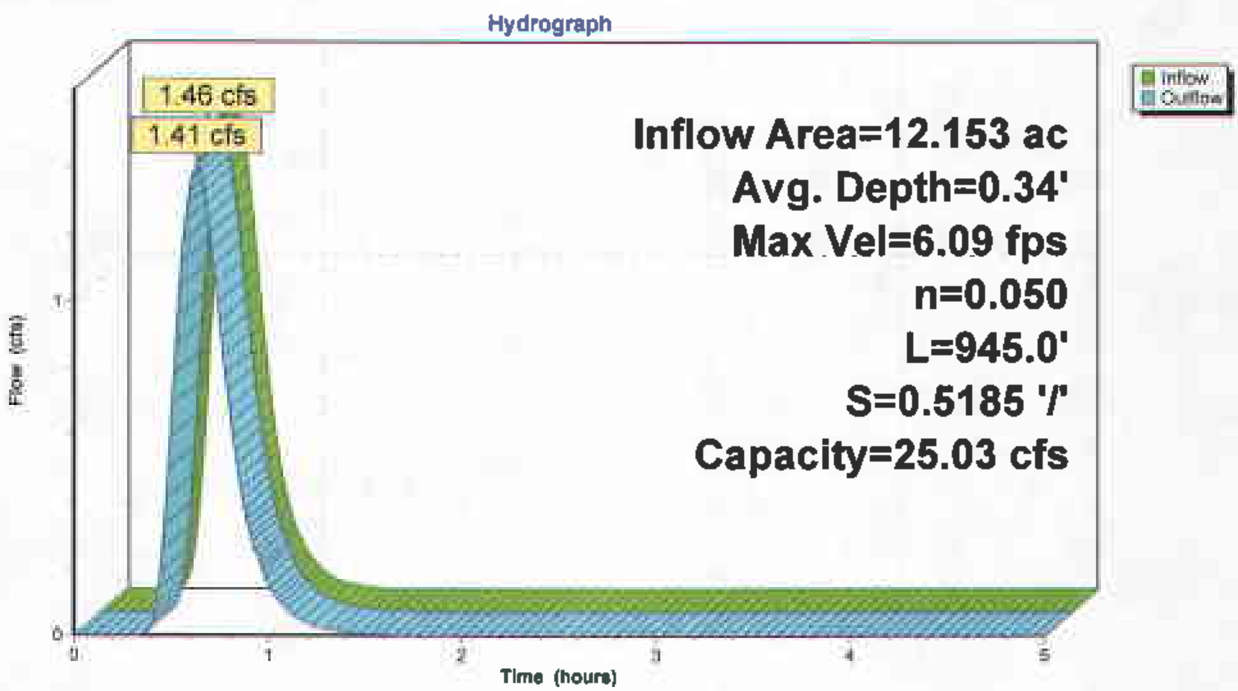
Inflow Area = 12.153 ac, 0.00% Impervious, Inflow Depth = 0.04"
Inflow = 1.46 cfs @ 0.55 hrs, Volume= 0.038 af
Outflow = 1.41 cfs @ 0.63 hrs, Volume= 0.038 af, Atten= 3%, Lag= 4.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.09 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 2.27 fps, Avg. Travel Time= 6.9 min

Peak Storage= 218 cf @ 0.59 hrs, Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 25.03 cfs

0.00' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 945.0' Slope= 0.5185 '/'
Inlet Invert= 6,500.00', Outlet Invert= 6,010.00'

Reach R1: Channel #4



Summary for Reach R2: Channel #4

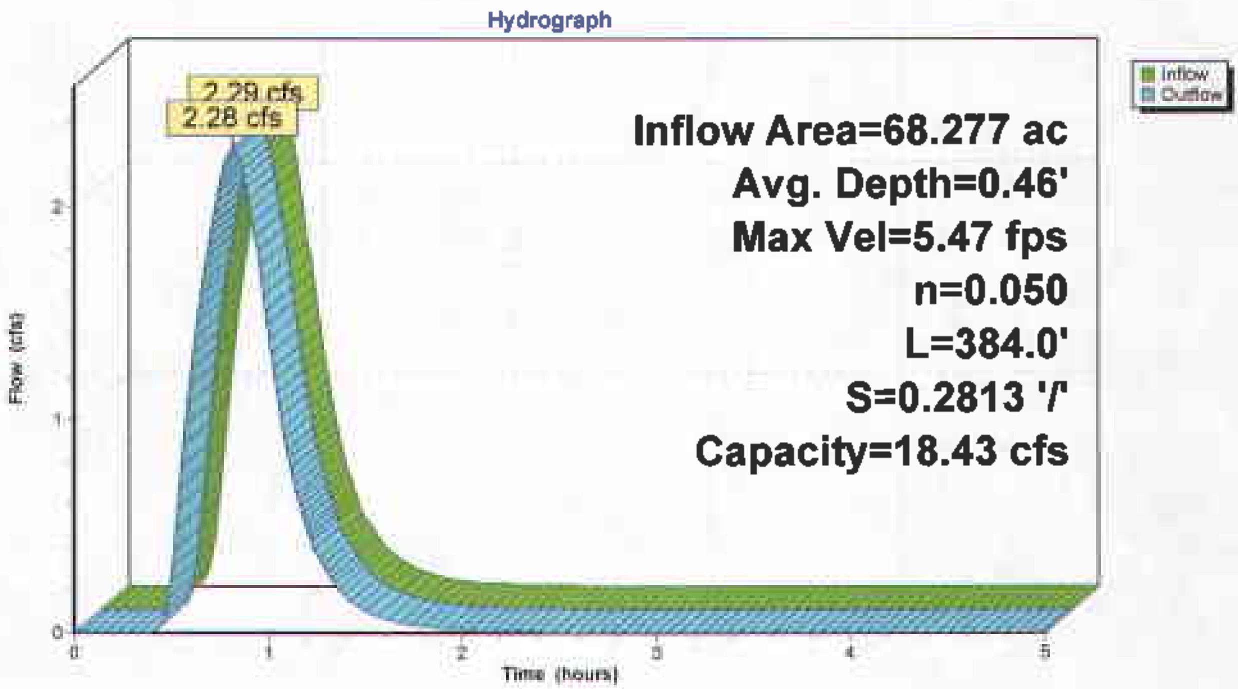
Inflow Area = 68.277 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 2.29 cfs @ 0.79 hrs, Volume= 0.092 af
Outflow = 2.28 cfs @ 0.82 hrs, Volume= 0.092 af, Atten= 0%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.47 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.68 fps, Avg. Travel Time= 3.8 min

Peak Storage= 160 cf @ 0.80 hrs, Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 18.43 cfs

0.00' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 384.0' Slope= 0.2813 '/'
Inlet Invert= 6,009.00', Outlet Invert= 5,901.00'

Reach R2: Channel #4



Summary for Reach R4: Channel #4

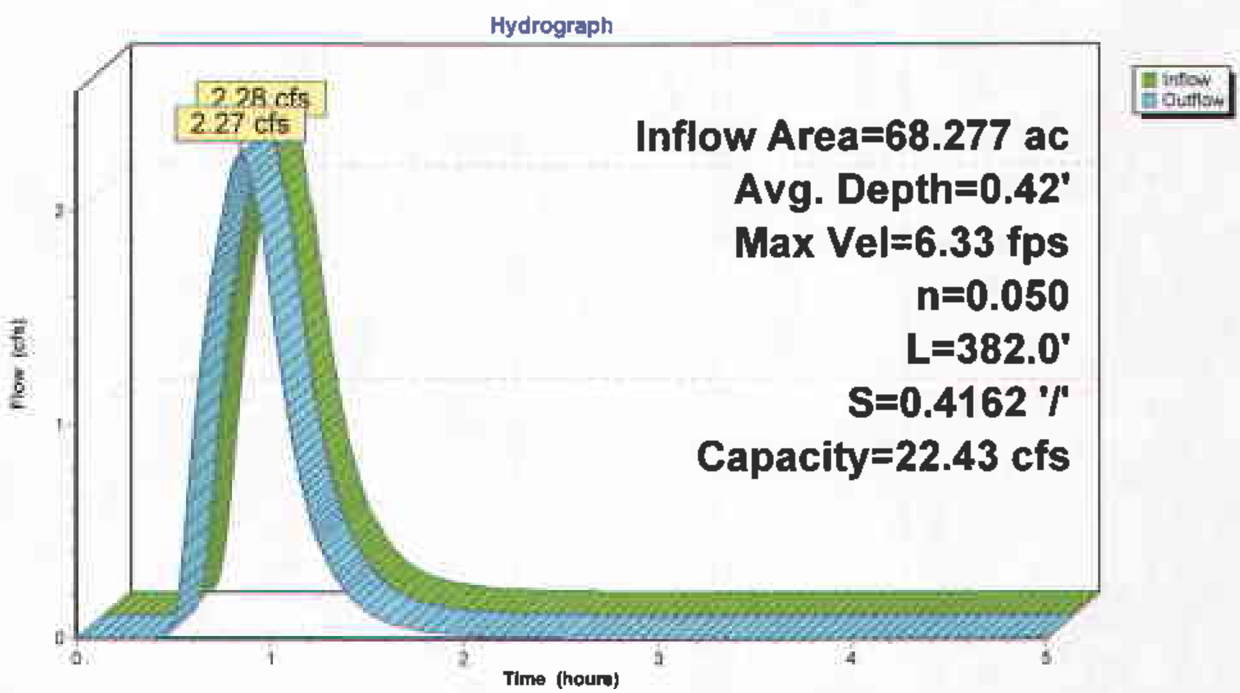
Inflow Area = 68.277 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 2.28 cfs @ 0.82 hrs, Volume= 0.092 af
Outflow = 2.27 cfs @ 0.85 hrs, Volume= 0.092 af, Atten= 0%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.33 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.98 fps, Avg. Travel Time= 3.2 min

Peak Storage= 137 cf @ 0.83 hrs, Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 22.43 cfs

0.00' x 1.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 382.0' Slope= 0.4162 '/'
Inlet Invert= 5,899.00', Outlet Invert= 5,740.00'

Reach R4: Channel #4



Summary for Reach R5: Channel #4

[62] Warning: Exceeded Reach P3 OUTLET depth by 10.12' @ 1.10 hrs

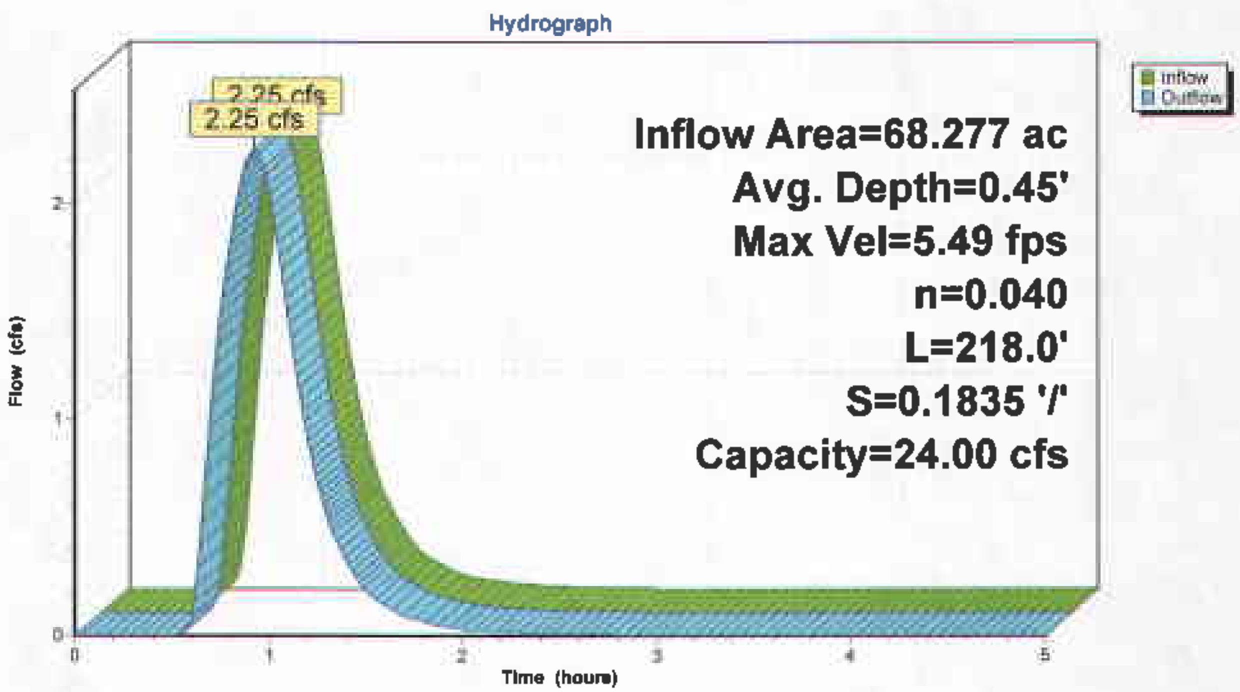
Inflow Area =	68.277 ac,	0.00% Impervious,	Inflow Depth = 0.02"		
Inflow =	2.25 cfs @	0.90 hrs,	Volume=	0.092 af	
Outflow =	2.25 cfs @	0.92 hrs,	Volume=	0.092 af,	Atten= 0%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.49 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.82 fps, Avg. Travel Time= 2.0 min

Peak Storage= 89 cf @ 0.91 hrs, Average Depth at Peak Storage= 0.45'
Bank-Full Depth= 1.10', Capacity at Bank-Full= 24.00 cfs

0.00' x 1.10' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 4.40'
Length= 218.0' Slope= 0.1835 '/'
Inlet Invert= 5,580.00', Outlet Invert= 5,540.00'

Reach R5: Channel #4



Summary for Reach R6: Channel #4

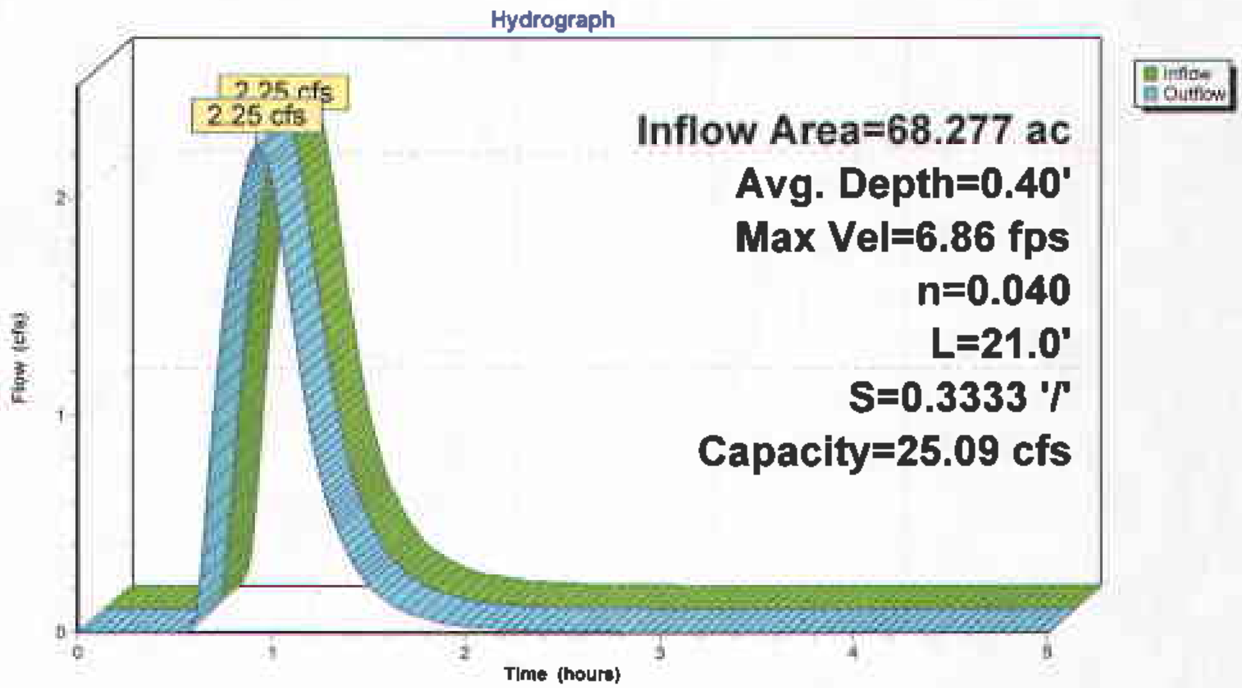
Inflow Area =	68.277 ac,	0.00% Impervious,	Inflow Depth = 0.02"	
Inflow =	2.25 cfs @	0.93 hrs, Volume=	0.092 af	
Outflow =	2.25 cfs @	0.93 hrs, Volume=	0.092 af,	Atten= 0%, Lag= 0.1 min

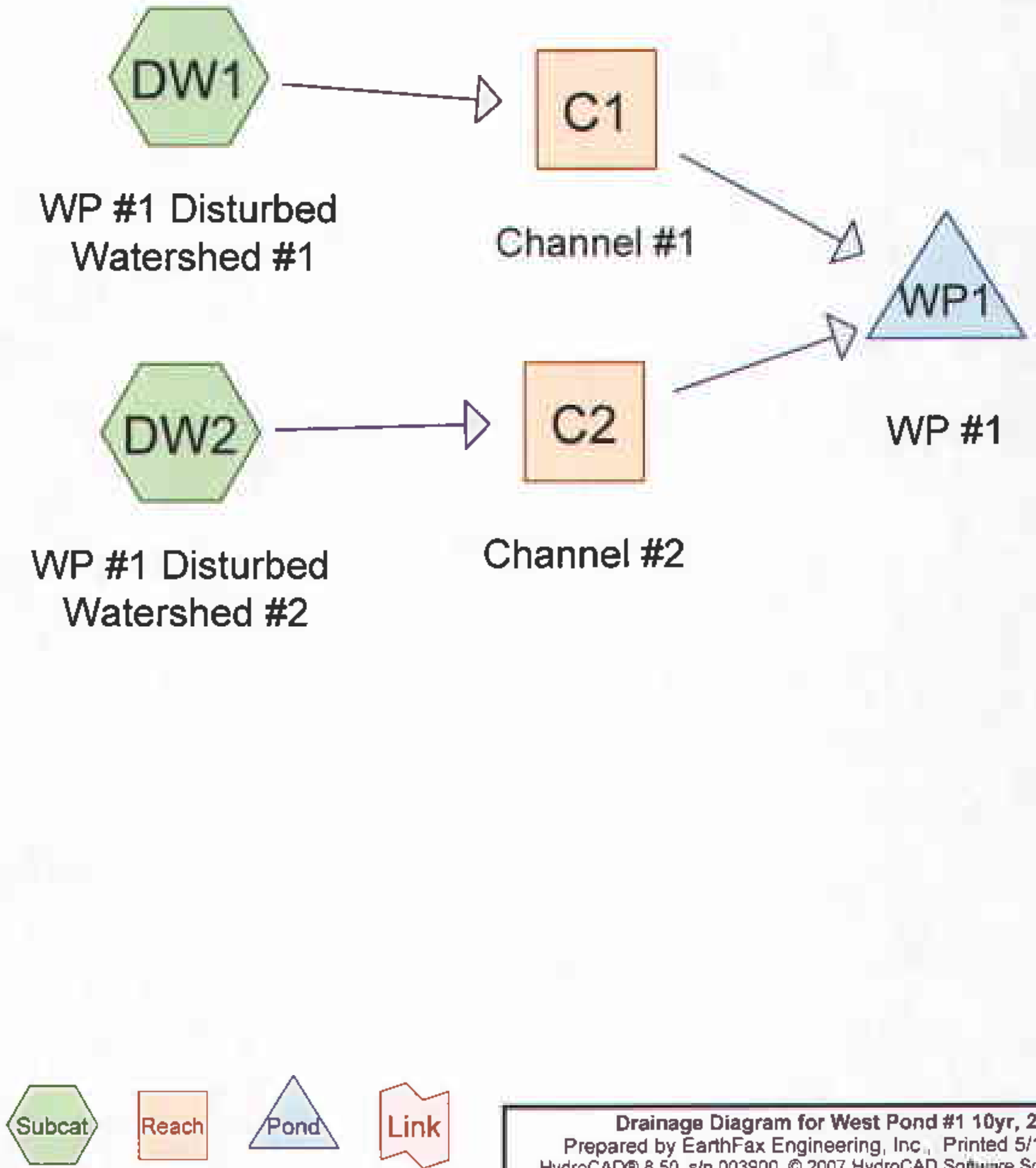
Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.86 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.29 fps, Avg. Travel Time= 0.2 min

Peak Storage= 7 cf @ 0.93 hrs, Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 25.09 cfs

0.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 21.0' Slope= 0.3333 '/'
Inlet Invert= 5,537.00', Outlet Invert= 5,530.00'

Reach R6: Channel #4





Drainage Diagram for West Pond #1 10yr, 24hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentDW1: WP #1 Disturbed Runoff Area=4.540 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=430' Slope=0.3488 '/' Tc=2.6 min CN=82 Runoff=4.30 cfs 0.185 af

SubcatchmentDW2: WP #1 Disturbed Runoff Area=17.730 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=860' Slope=0.4190 '/' Tc=4.1 min CN=82 Runoff=15.93 cfs 0.724 af

Reach C1: Channel #1 Avg. Depth=0.33' Max Vel=3.36 fps Inflow=4.30 cfs 0.185 af
n=0.022 L=700.0' S=0.0286 '/' Capacity=46.47 cfs Outflow=3.53 cfs 0.185 af

Reach C2: Channel #2 Avg. Depth=0.57' Max Vel=3.87 fps Inflow=15.93 cfs 0.724 af
n=0.022 L=1,140.0' S=0.0175 '/' Capacity=56.17 cfs Outflow=12.12 cfs 0.724 af

Pond WP1: WP #1 Peak Elev=6,779.75' Storage=39,626 cf Inflow=14.99 cfs 0.910 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 22.270 ac Runoff Volume = 0.910 af Average Runoff Depth = 0.49"
100.00% Pervious = 22.270 ac 0.00% Impervious = 0.000 ac

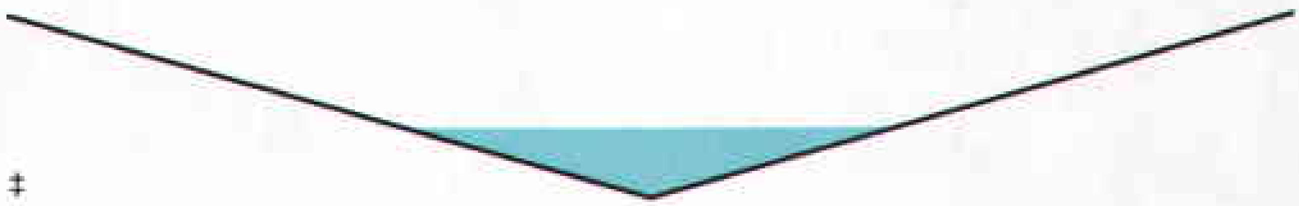
Summary for Reach C1: Channel #1

Inflow Area = 4.540 ac, 0.00% Impervious, Inflow Depth = 0.49"
Inflow = 4.30 cfs @ 11.94 hrs, Volume= 0.185 af
Outflow = 3.53 cfs @ 12.03 hrs, Volume= 0.185 af, Atten= 18%, Lag= 5.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.36 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 1.25 fps, Avg. Travel Time= 9.4 min

Peak Storage= 744 cf @ 11.97 hrs, Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 0.85', Capacity at Bank-Full= 46.47 cfs

0.00' x 0.85' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 17.00'
Length= 700.0' Slope= 0.0286 '/'
Inlet Invert= 6,800.00', Outlet Invert= 6,780.00'



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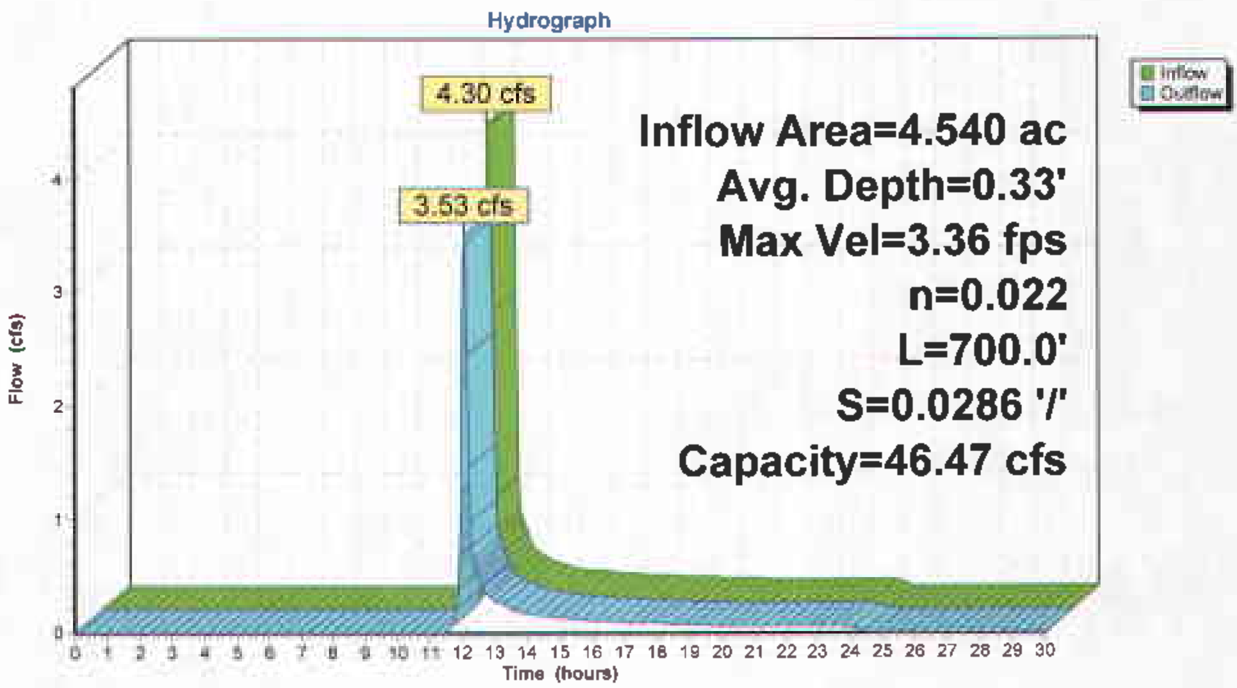
Reach C1: Channel #1



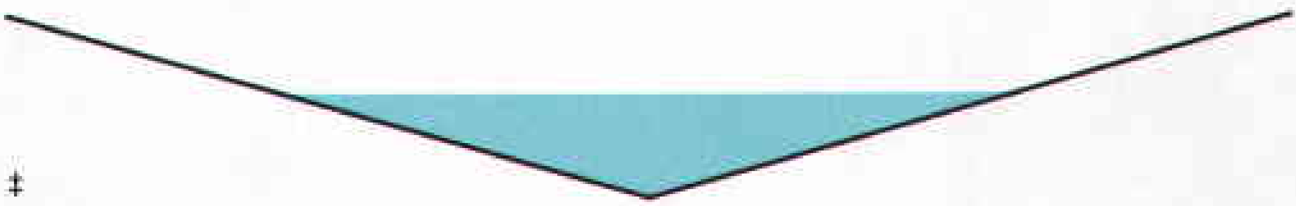
Summary for Reach C2: Channel #2

Inflow Area = 17.730 ac, 0.00% Impervious, Inflow Depth = 0.49"
Inflow = 15.93 cfs @ 11.96 hrs, Volume= 0.724 af
Outflow = 12.12 cfs @ 12.09 hrs, Volume= 0.724 af, Atten= 24%, Lag= 8.0 min

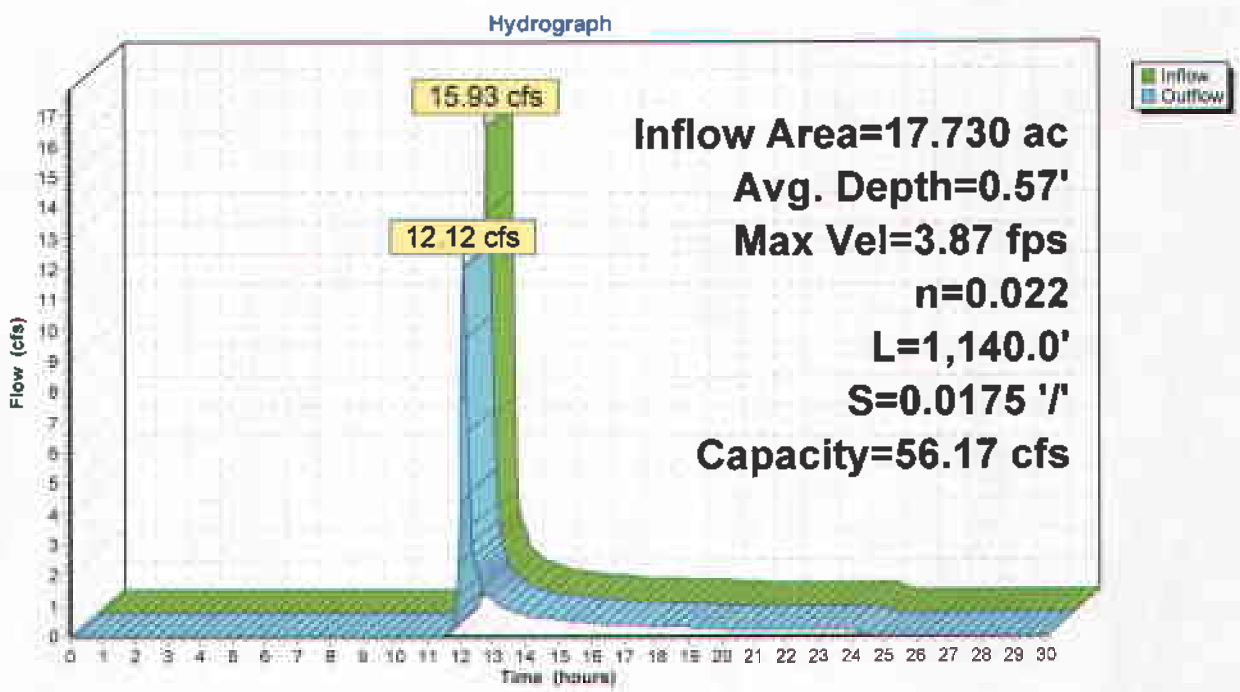
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.87 fps, Min. Travel Time= 4.9 min
Avg. Velocity = 1.27 fps, Avg. Travel Time= 14.9 min

Peak Storage= 3,733 cf @ 12.00 hrs, Average Depth at Peak Storage= 0.57'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 56.17 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 20.00'
Length= 1,140.0' Slope= 0.0175 '/'
Inlet Invert= 6,800.00', Outlet Invert= 6,780.00'



Reach C2: Channel #2



Summary for Pond WP1: WP #1

Inflow Area = 22.270 ac, 0.00% Impervious, Inflow Depth = 0.49"
Inflow = 14.99 cfs @ 12.07 hrs, Volume= 0.910 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 6,779.75' @ 30.00 hrs Surf.Area= 6,528 sf Storage= 39,626 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

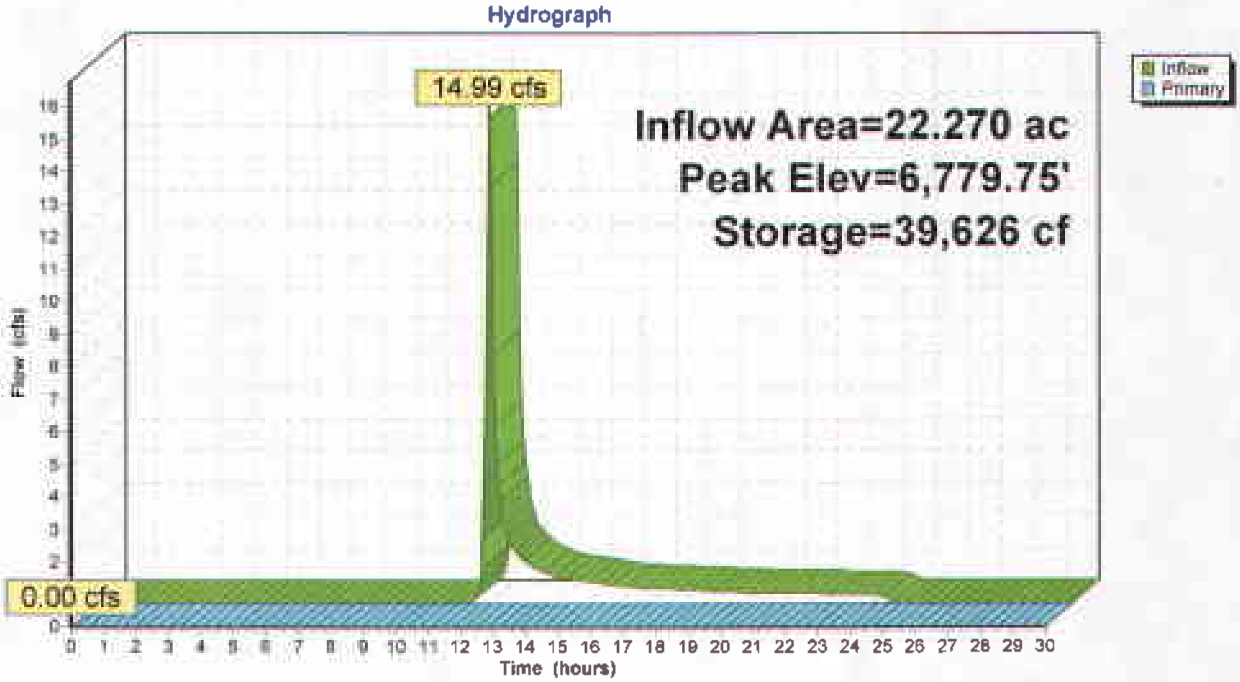
Volume	Invert	Avail.Storage	Storage Description
#1	6,769.00'	48,129 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,769.00	1,594	0	0
6,770.00	1,900	1,747	1,747
6,771.00	2,080	1,990	3,737
6,772.00	2,464	2,272	6,009
6,773.00	2,880	2,672	8,681
6,774.00	3,328	3,104	11,785
6,775.00	3,808	3,568	15,353
6,776.00	4,320	4,064	19,417
6,777.00	4,864	4,592	24,009
6,778.00	5,440	5,152	29,161
6,779.00	6,048	5,744	34,905
6,780.00	6,688	6,368	41,273
6,781.00	7,024	6,856	48,129

Device	Routing	Invert	Outlet Devices
#1	Primary	6,780.00'	**Special & User-Defined** Head (feet) 0.00 0.74 Disch. (cfs) 0.000 9.190

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=6,769.00' (Free Discharge)
1=Special & User-Defined (Controls 0.00 cfs)

Pond WP1: WP #1


Hydrograph
14.99 cfs
0.00 cfs
Inflow Area=22.270 ac
Peak Elev=6,779.75'
Storage=39,626 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
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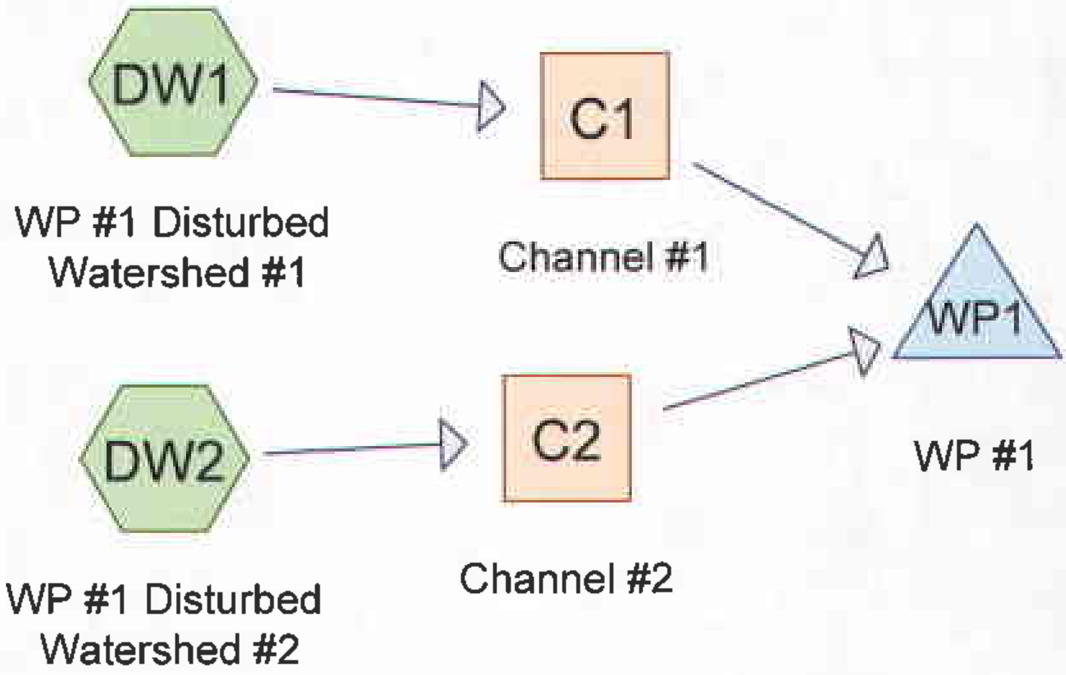
30



Drainage Diagram for West Pond #1 25yr, 6hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-12.00 hrs, dt=0.05 hrs, 241 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentDW1: WP #1 Disturbed Runoff Area=4.540 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=430' Slope=0.3488 '/' Tc=2.6 min CN=82 Runoff=5.73 cfs 0.113 af

SubcatchmentDW2: WP #1 Disturbed Runoff Area=17.730 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=860' Slope=0.4190 '/' Tc=4.1 min CN=82 Runoff=17.59 cfs 0.440 af

Reach C1: Channel #1 Avg. Depth=0.33' Max Vel=3.39 fps Inflow=5.73 cfs 0.113 af
n=0.022 L=700.0' S=0.0286 '/' Capacity=46.47 cfs Outflow=3.42 cfs 0.113 af

Reach C2: Channel #2 Avg. Depth=0.54' Max Vel=3.73 fps Inflow=17.59 cfs 0.440 af
n=0.022 L=1,140.0' S=0.0175 '/' Capacity=56.17 cfs Outflow=10.31 cfs 0.440 af

Pond WP1: WP #1 Peak Elev=6,780.10' Storage=7,038 cf Inflow=12.75 cfs 0.553 af
Outflow=8.17 cfs 0.406 af

Total Runoff Area = 22.270 ac Runoff Volume = 0.553 af Average Runoff Depth = 0.30"
100.00% Pervious = 22.270 ac 0.00% Impervious = 0.000 ac

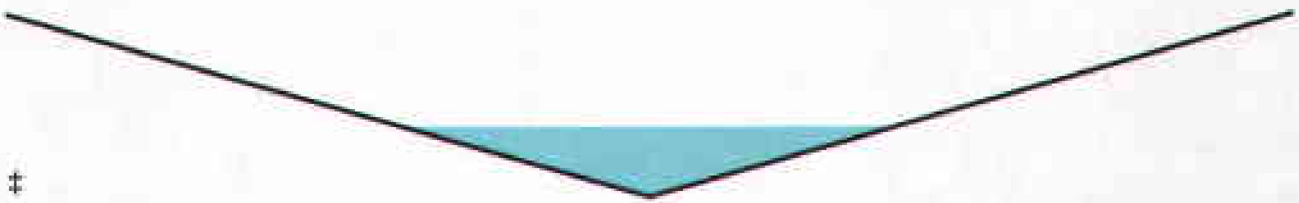
Summary for Reach C1: Channel #1

Inflow Area = 4.540 ac, 0.00% Impervious, Inflow Depth = 0.30"
Inflow = 5.73 cfs @ 3.01 hrs, Volume= 0.113 af
Outflow = 3.42 cfs @ 3.11 hrs, Volume= 0.113 af, Atten= 40%, Lag= 6.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.39 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 1.19 fps, Avg. Travel Time= 9.8 min

Peak Storage= 749 cf @ 3.06 hrs, Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 0.85', Capacity at Bank-Full= 46.47 cfs

0.00' x 0.85' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 17.00'
Length= 700.0' Slope= 0.0286 '/'
Inlet Invert= 6,800.00', Outlet Invert= 6,780.00'



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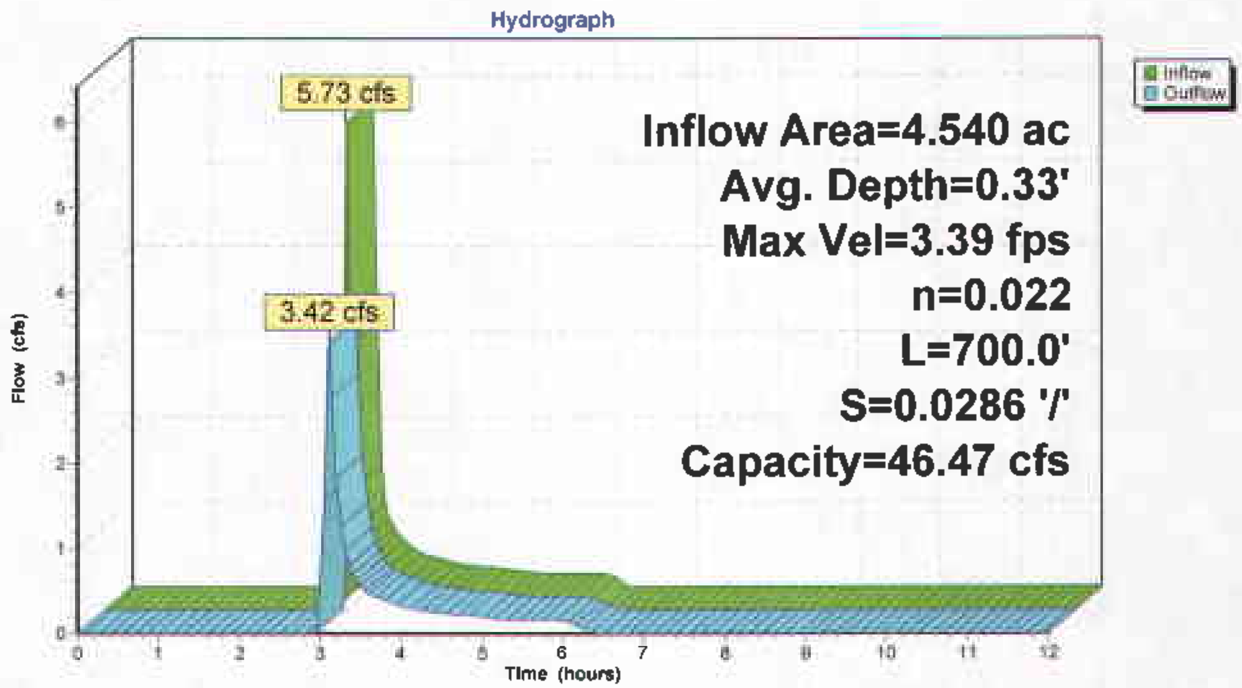
Reach C1: Channel #1



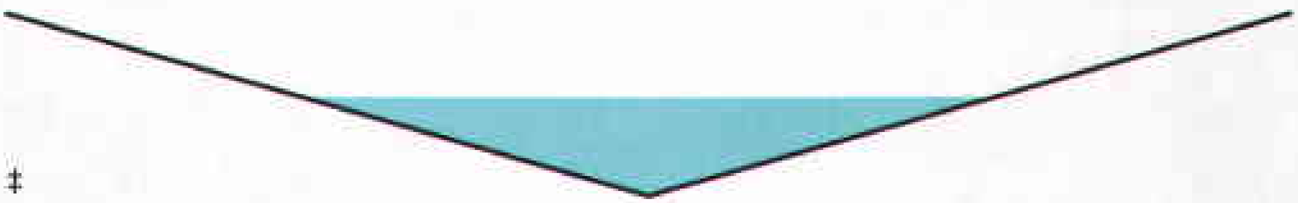
Summary for Reach C2: Channel #2

Inflow Area = 17.730 ac, 0.00% Impervious, Inflow Depth = 0.30"
Inflow = 17.59 cfs @ 3.04 hrs, Volume= 0.440 af
Outflow = 10.31 cfs @ 3.19 hrs, Volume= 0.440 af, Atten= 41%, Lag= 8.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.73 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 1.04 fps, Avg. Travel Time= 18.3 min

Peak Storage= 3,346 cf @ 3.10 hrs, Average Depth at Peak Storage= 0.54'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 56.17 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 20.00'
Length= 1,140.0' Slope= 0.0175 '/'
Inlet Invert= 6,800.00', Outlet Invert= 6,780.00'



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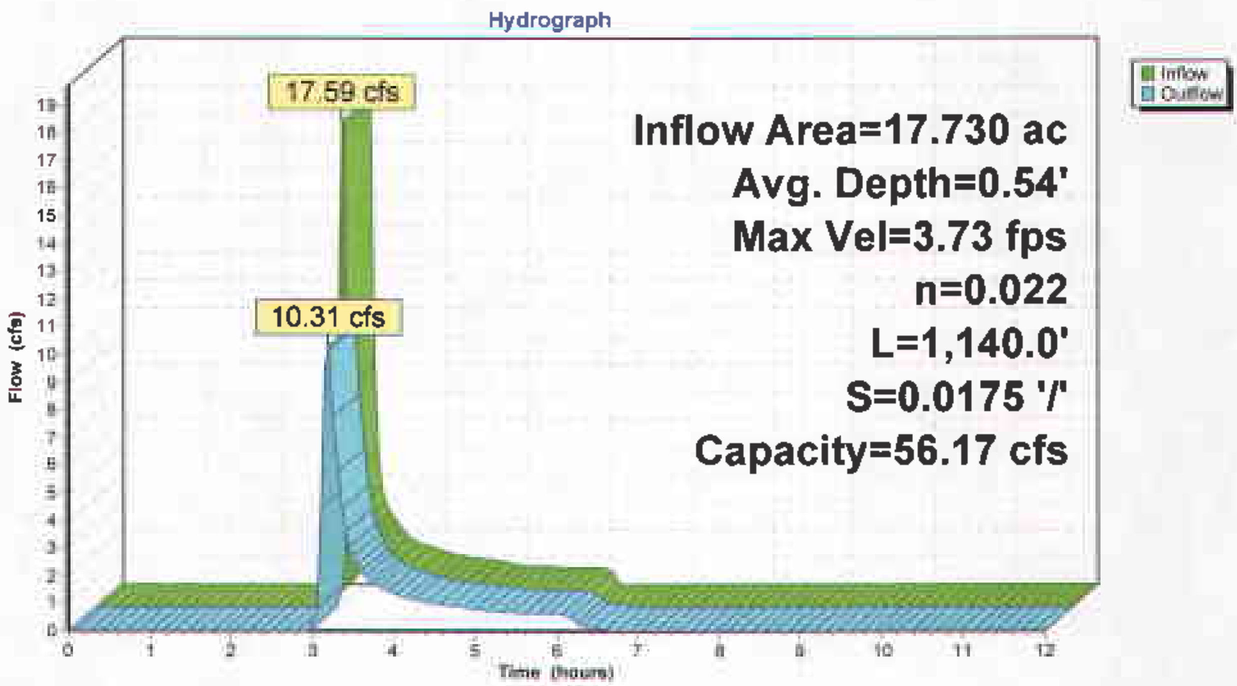
Reach C2: Channel #2



Summary for Pond WP1: WP #1

[61] Hint: Exceeded Reach C1 outlet invert by 0.10' @ 3.30 hrs
[61] Hint: Exceeded Reach C2 outlet invert by 0.10' @ 3.30 hrs

Inflow Area = 22.270 ac, 0.00% Impervious, Inflow Depth = 0.30"
Inflow = 12.75 cfs @ 3.17 hrs, Volume= 0.553 af
Outflow = 8.17 cfs @ 3.31 hrs, Volume= 0.406 af, Atten= 36%, Lag= 8.1 min
Primary = 8.17 cfs @ 3.31 hrs, Volume= 0.406 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Peak Elev= 6,780.10' @ 3.31 hrs Surf.Area= 6,722 sf Storage= 7,038 cf

Plug-Flow detention time= 46.0 min calculated for 0.405 af (73% of inflow)
Center-of-Mass det. time= 18.1 min (253.5 - 235.4)

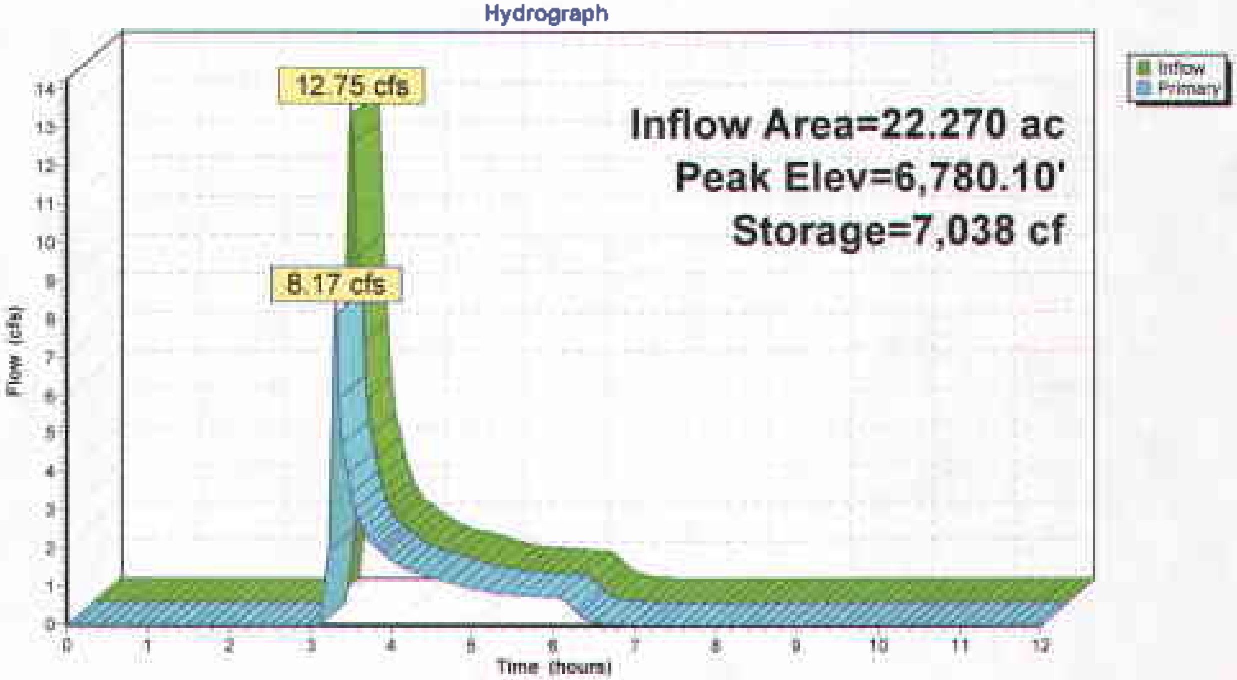
Volume	Invert	Avail.Storage	Storage Description
#1	6,769.00'	13,224 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,769.00	1,594	0.0	0	0
6,770.00	1,900	0.0	0	0
6,771.00	2,080	0.0	0	0
6,772.00	2,464	0.0	0	0
6,773.00	2,880	0.0	0	0
6,774.00	3,328	0.0	0	0
6,775.00	3,808	0.0	0	0
6,776.00	4,320	0.0	0	0
6,777.00	4,864	0.0	0	0
6,778.00	5,440	0.0	0	0
6,779.00	6,048	0.0	0	0
6,780.00	6,688	100.0	6,368	6,368
6,781.00	7,024	100.0	6,856	13,224

Device	Routing	Invert	Outlet Devices
#1	Primary	6,780.00'	**Special & User-Defined** Head (feet) 0.00 0.10 Disch. (cfs) 0.000 8.170

Primary OutFlow Max=7.75 cfs @ 3.31 hrs HW=6,780.09' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 7.75 cfs)

Pond WP1: WP #1

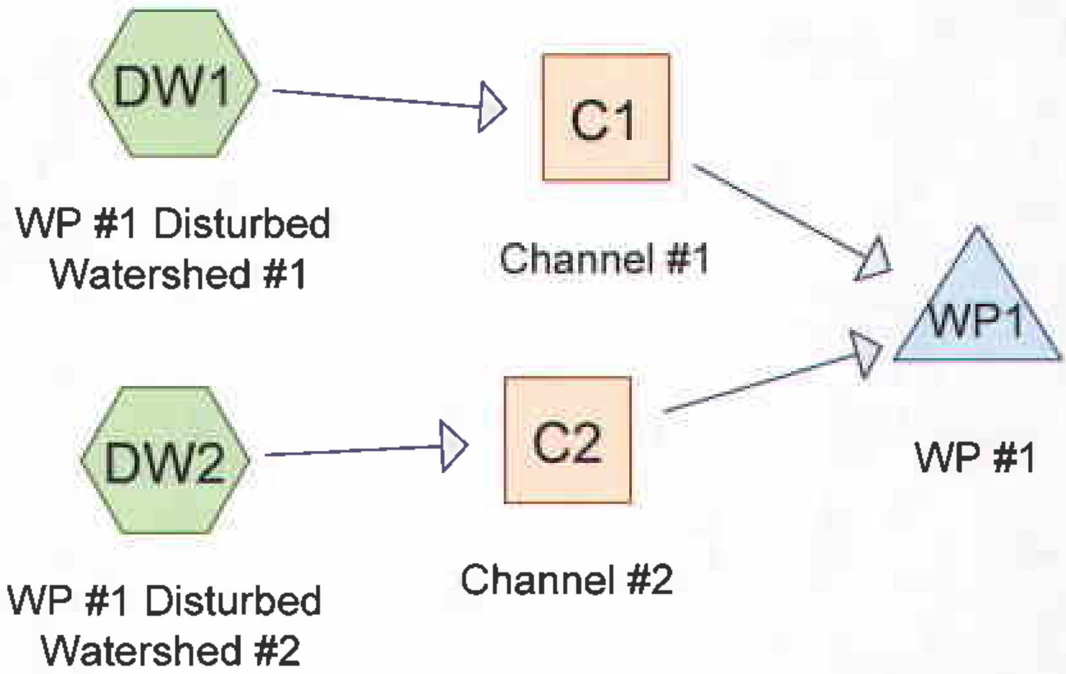

Hydrograph
Inflow
Primary
12.75 cfs
8.17 cfs
Inflow Area=22.270 ac
Peak Elev=6,780.10'
Storage=7,038 cf
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

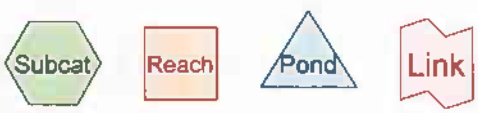
West Pond #1 Spillway
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	West Pond #1 Spi
Flow Element	Trapezoidal Chan
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	010000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Bottom Width	1.00	ft
Discharge	8.17	cfs

Results		
Depth	1.04	ft
Flow Area	3.2	ft²
Wetted Perim	5.66	ft
Top Width	5.16	ft
Critical Depth	0.79	ft
Critical Slope	0.033122	ft/ft
Velocity	2.55	ft/s
Velocity Head	0.10	ft
Specific Energ	1.14	ft
Froude Numb	0.57	
Flow Type	Subcritical	





Drainage Diagram for West Pond #1 100yr, 0.5hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-5.00 hrs, dt=0.05 hrs, 101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW1: WP #1 Disturbed Runoff Area=4.540 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=430' Slope=0.3488 '/' Tc=2.6 min CN=82 Runoff=8.11 cfs 0.079 af

Subcatchment DW2: WP #1 Disturbed Runoff Area=17.730 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=860' Slope=0.4190 '/' Tc=4.1 min CN=82 Runoff=26.06 cfs 0.310 af

Reach C1: Channel #1 Avg. Depth=0.37' Max Vel=3.72 fps Inflow=8.11 cfs 0.079 af
n=0.022 L=700.0' S=0.0286 '/' Capacity=46.47 cfs Outflow=5.09 cfs 0.079 af

Reach C2: Channel #2 Avg. Depth=0.61' Max Vel=4.04 fps Inflow=26.06 cfs 0.310 af
n=0.022 L=1,140.0' S=0.0175 '/' Capacity=56.17 cfs Outflow=15.09 cfs 0.310 af

Pond WP1: WP #1 Peak Elev=6,775.40' Storage=16,936 cf Inflow=18.35 cfs 0.389 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 22.270 ac Runoff Volume = 0.389 af Average Runoff Depth = 0.21"
100.00% Pervious = 22.270 ac 0.00% Impervious = 0.000 ac

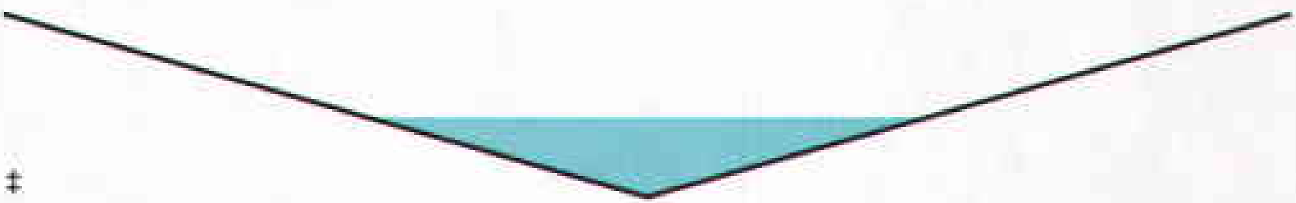
Summary for Reach C1: Channel #1

Inflow Area = 4.540 ac, 0.00% Impervious, Inflow Depth = 0.21"
Inflow = 8.11 cfs @ 0.30 hrs, Volume= 0.079 af
Outflow = 5.09 cfs @ 0.40 hrs, Volume= 0.079 af, Atten= 37%, Lag= 5.9 min

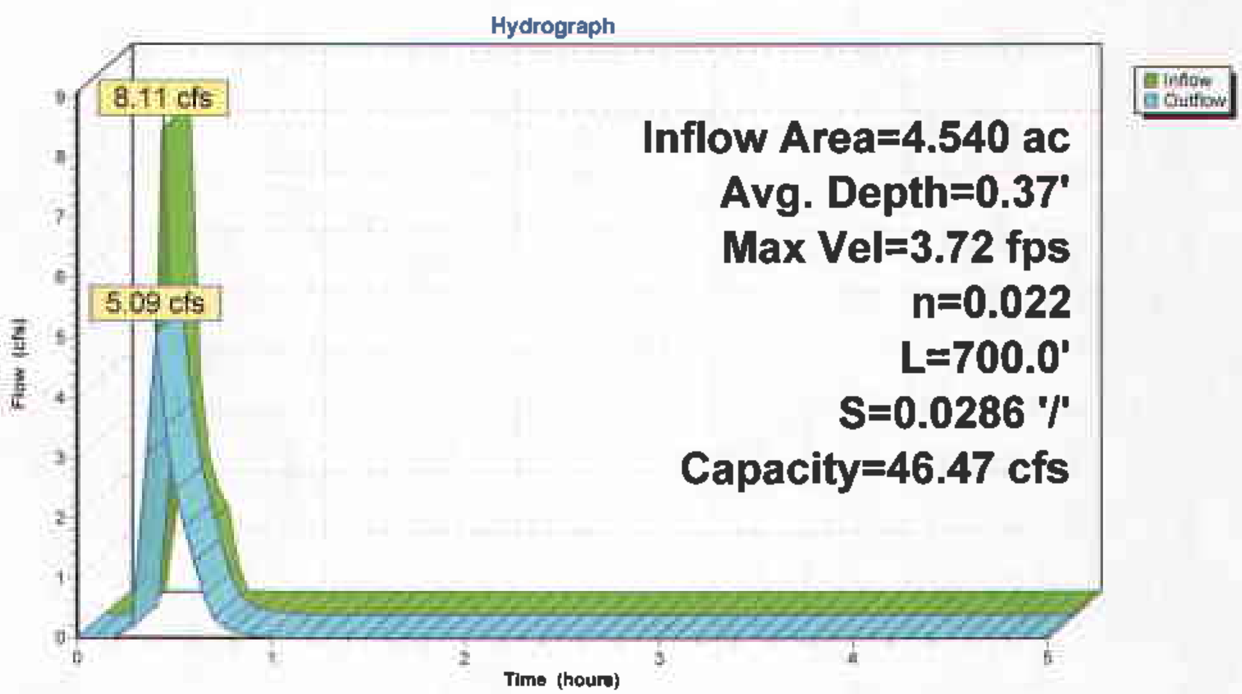
Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.72 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 14.6 min

Peak Storage= 976 cf @ 0.35 hrs, Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 0.85', Capacity at Bank-Full= 46.47 cfs

0.00' x 0.85' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 17.00'
Length= 700.0' Slope= 0.0286 '/'
Inlet Invert= 6,800.00', Outlet Invert= 6,780.00'



Reach C1: Channel #1



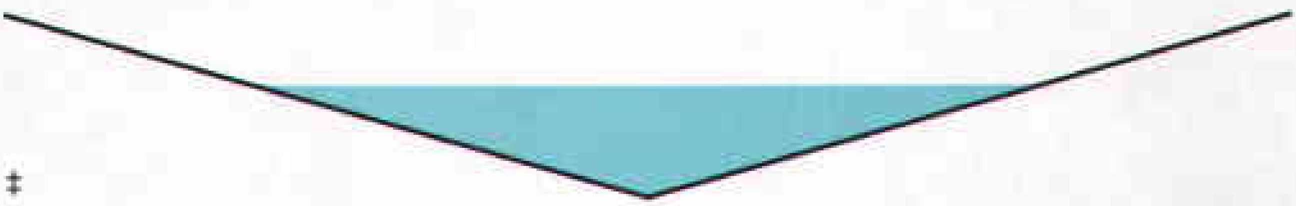
Summary for Reach C2: Channel #2

Inflow Area = 17.730 ac, 0.00% Impervious, Inflow Depth = 0.21"
Inflow = 26.06 cfs @ 0.32 hrs, Volume= 0.310 af
Outflow = 15.09 cfs @ 0.47 hrs, Volume= 0.310 af, Atten= 42%, Lag= 9.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.04 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 23.6 min

Peak Storage= 4,293 cf @ 0.38 hrs, Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 56.17 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 '/' Top Width= 20.00'
Length= 1,140.0' Slope= 0.0175 '/'
Inlet Invert= 6,800.00', Outlet Invert= 6,780.00'



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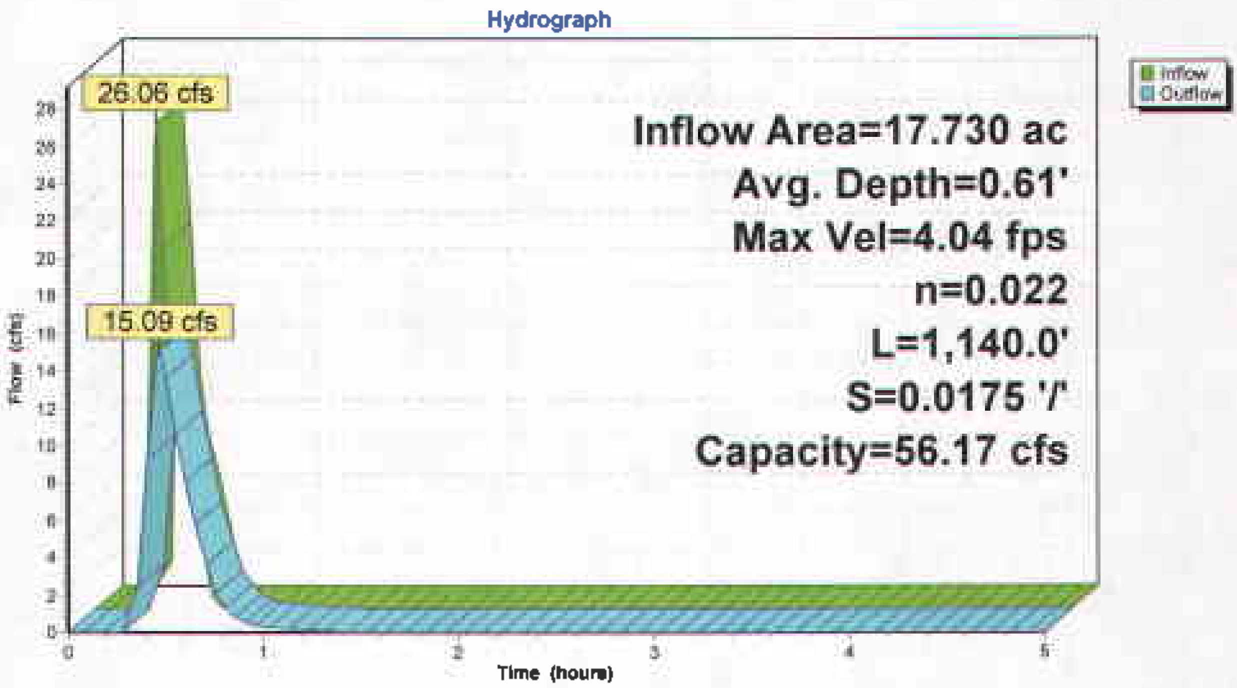
Reach C2: Channel #2



Summary for Pond WP1: WP #1

Inflow Area = 22.270 ac, 0.00% Impervious, Inflow Depth = 0.21"
Inflow = 18.35 cfs @ 0.46 hrs, Volume= 0.389 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-5.00 hrs, dt= 0.05 hrs
Peak Elev= 6,775.40' @ 5.00 hrs Surf.Area= 4,015 sf Storage= 16,936 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

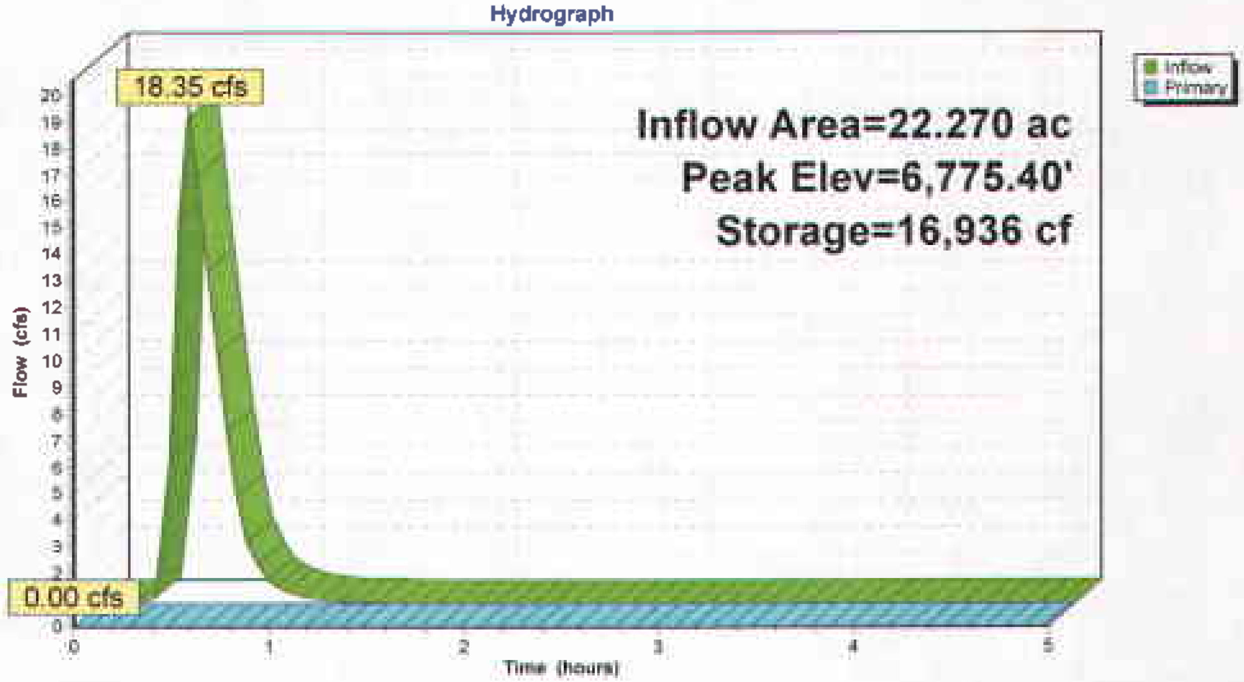
Volume	Invert	Avail.Storage	Storage Description
#1	6,769.00'	48,129 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

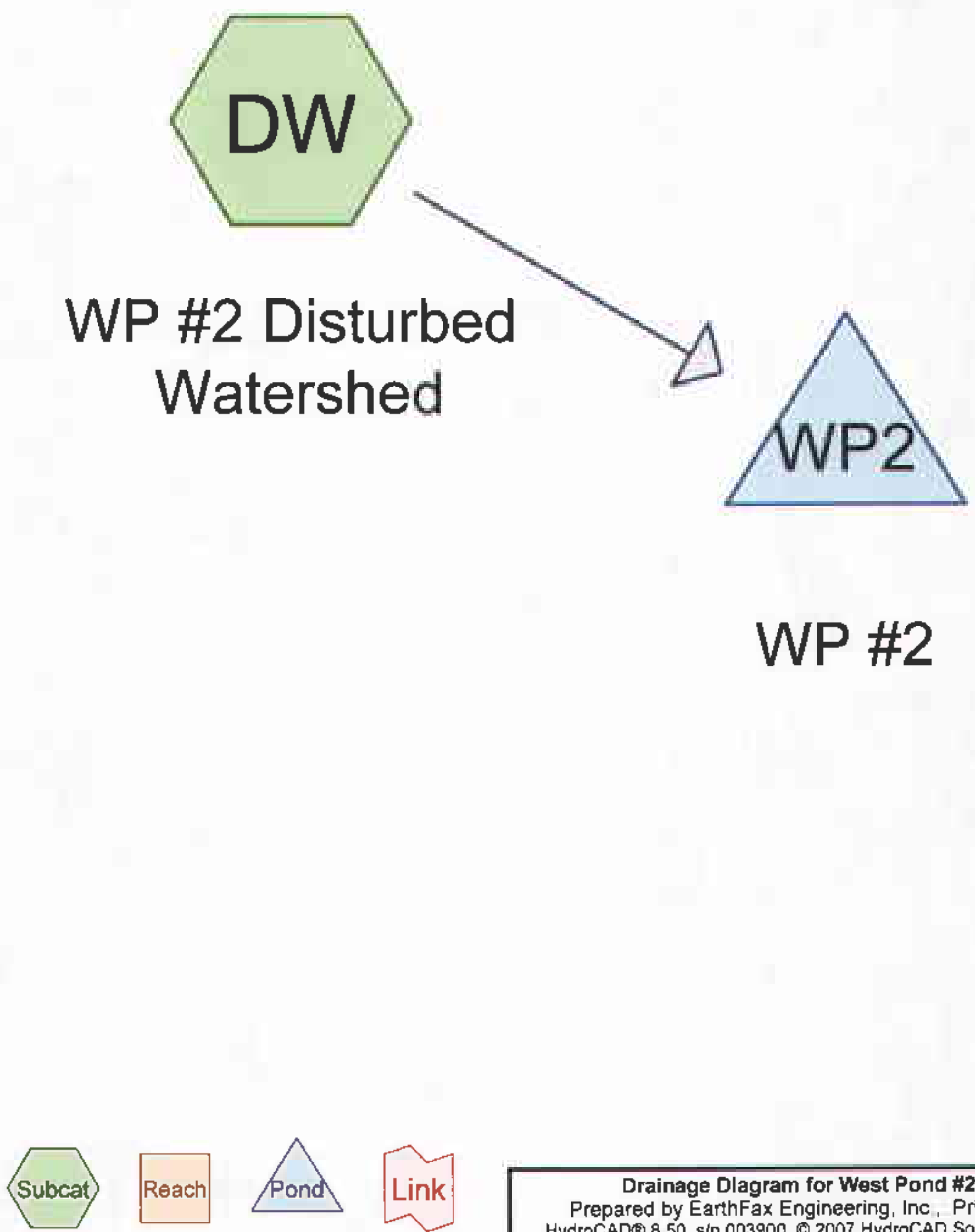
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,769.00	1,594	0	0
6,770.00	1,900	1,747	1,747
6,771.00	2,080	1,990	3,737
6,772.00	2,464	2,272	6,009
6,773.00	2,880	2,672	8,681
6,774.00	3,328	3,104	11,785
6,775.00	3,808	3,568	15,353
6,776.00	4,320	4,064	19,417
6,777.00	4,864	4,592	24,009
6,778.00	5,440	5,152	29,161
6,779.00	6,048	5,744	34,905
6,780.00	6,688	6,368	41,273
6,781.00	7,024	6,856	48,129

Device	Routing	Invert	Outlet Devices
#1	Primary	6,780.00'	**Special & User-Defined** Head (feet) 0.00 0.74 Disch. (cfs) 0.000 9.190

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=6,769.00' (Free Discharge)
└─**1=Special & User-Defined** (Controls 0.00 cfs)

Pond WP1: WP #1


Hydrograph
18.35 cfs
0.00 cfs
Inflow Area=22.270 ac
Peak Elev=6,775.40'
Storage=16,936 cf
Inflow
Primary
Flow (cfs)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Time (hours)
0
1
2
3
4
5



Drainage Diagram for West Pond #2 10yr, 24hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW: WP #2 Disturbed Runoff Area=17.920 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=2,014' Slope=0.1740 '/' Tc=12.5 min CN=82 Runoff=11.59 cfs 0.732 af

Pond WP2: WP #2 Peak Elev=6,318.71' Storage=31,886 cf Inflow=11.59 cfs 0.732 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 17.920 ac Runoff Volume = 0.732 af Average Runoff Depth = 0.49"
100.00% Pervious = 17.920 ac 0.00% Impervious = 0.000 ac

Summary for Pond WP2: WP #2

Inflow Area =	17.920 ac,	0.00% Impervious,	Inflow Depth = 0.49"	
Inflow =	11.59 cfs @	12.06 hrs, Volume=	0.732 af	
Outflow =	0.00 cfs @	0.00 hrs, Volume=	0.000 af,	Atten= 100%, Lag= 0.0 min
Primary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 6,318.71' @ 24.75 hrs Surf.Area= 5,727 sf Storage= 31,886 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

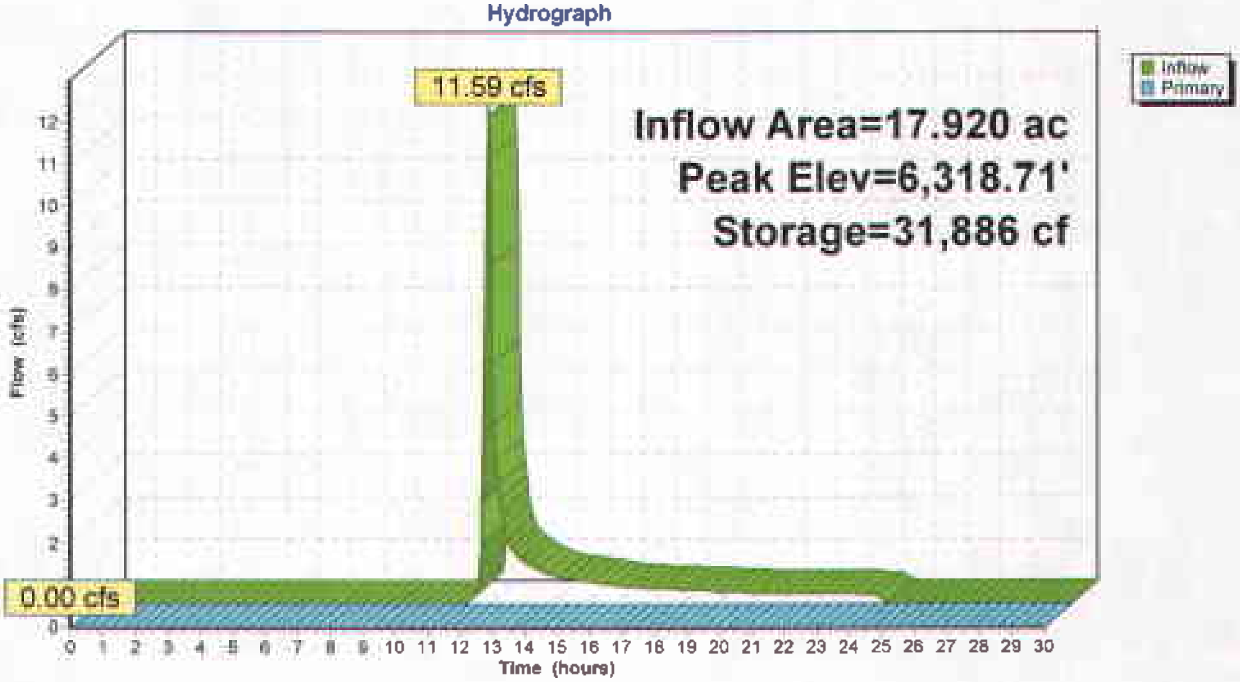
Volume	Invert	Avail.Storage	Storage Description
#1	6,309.00'	39,820 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,309.00	1,344	0	0
6,310.00	1,656	1,500	1,500
6,311.00	2,000	1,828	3,328
6,312.00	2,376	2,188	5,516
6,313.00	2,784	2,580	8,096
6,314.00	3,224	3,004	11,100
6,315.00	3,696	3,460	14,560
6,316.00	4,200	3,948	18,508
6,317.00	4,736	4,468	22,976
6,318.00	5,304	5,020	27,996
6,319.00	5,904	5,604	33,600
6,320.00	6,536	6,220	39,820

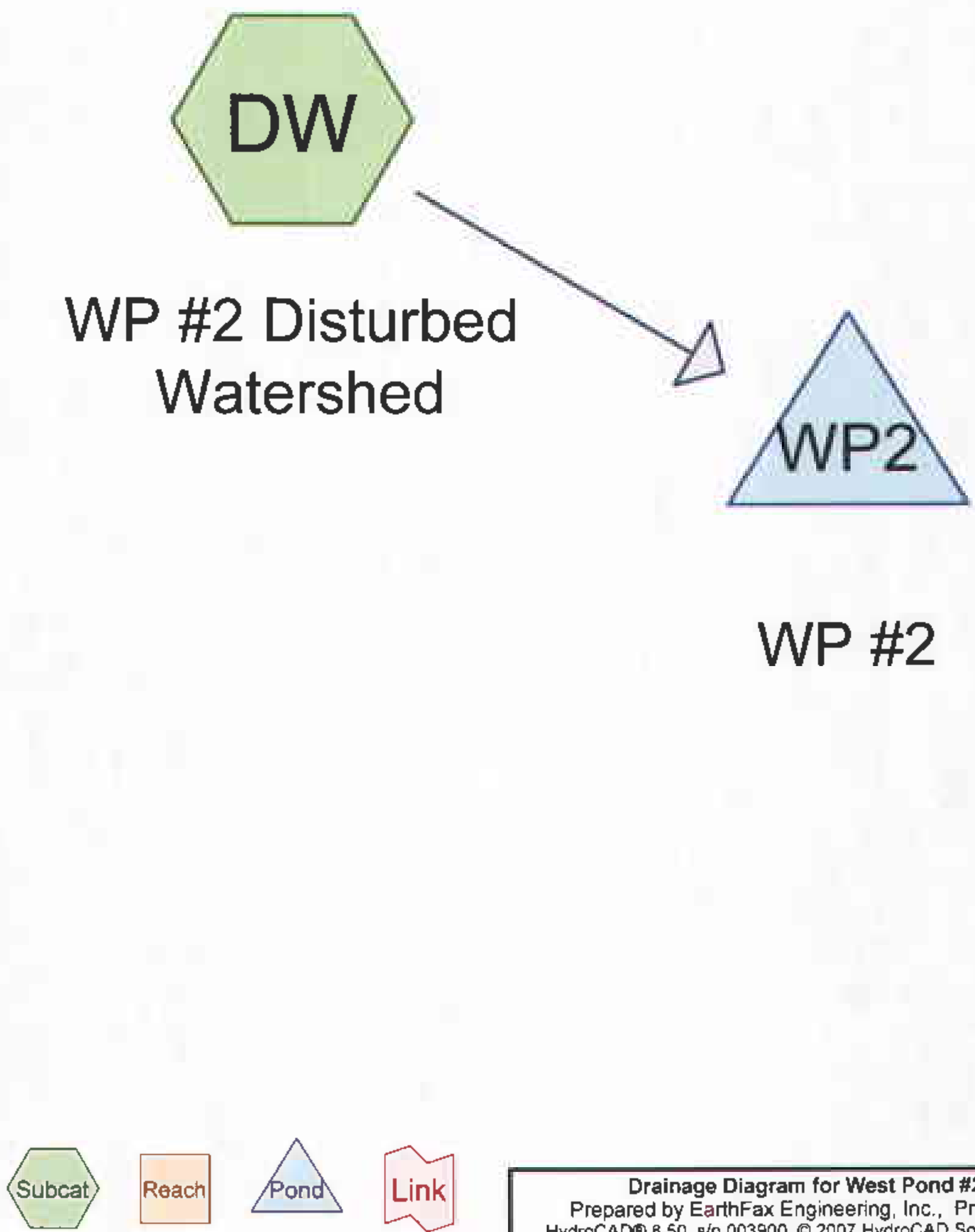
Device	Routing	Invert	Outlet Devices
#1	Primary	6,319.00'	**Special & User-Defined** Head (feet) 0.00 0.31 Disch. (cfs) 0.000 2.760

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=6,309.00' (Free Discharge)
↑—**1=Special & User-Defined** (Controls 0.00 cfs)

Pond WP2: WP #2



Hydrograph
11.59 cfs
0.00 cfs
Inflow Area=17.920 ac
Peak Elev=6,318.71'
Storage=31,886 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30



Drainage Diagram for West Pond #2 25yr, 6hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-12.00 hrs, dt=0.05 hrs, 241 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW: WP #2 Disturbed Runoff Area=17.688 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=2,014' Slope=0.1740 '/' Tc=12.5 min CN=82 Runoff=10.02 cfs 0.439 af

Pond WP2: WP #2 Peak Elev=6,319.34' Storage=7,627 cf Inflow=10.02 cfs 0.439 af
Outflow=2.76 cfs 0.310 af

Total Runoff Area = 17.688 ac Runoff Volume = 0.439 af Average Runoff Depth = 0.30"
100.00% Pervious = 17.688 ac 0.00% Impervious = 0.000 ac

Summary for Pond WP2: WP #2

Inflow Area = 17.688 ac, 0.00% Impervious, Inflow Depth = 0.30"
Inflow = 10.02 cfs @ 3.15 hrs, Volume= 0.439 af
Outflow = 2.76 cfs @ 3.40 hrs, Volume= 0.310 af, Atten= 72%, Lag= 15.0 min
Primary = 2.76 cfs @ 3.40 hrs, Volume= 0.310 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Peak Elev= 6,319.34' @ 3.46 hrs Surf.Area= 6,117 sf Storage= 7,627 cf

Plug-Flow detention time= 58.3 min calculated for 0.309 af (70% of inflow)
Center-of-Mass det. time= 29.4 min (260.9 - 231.5)

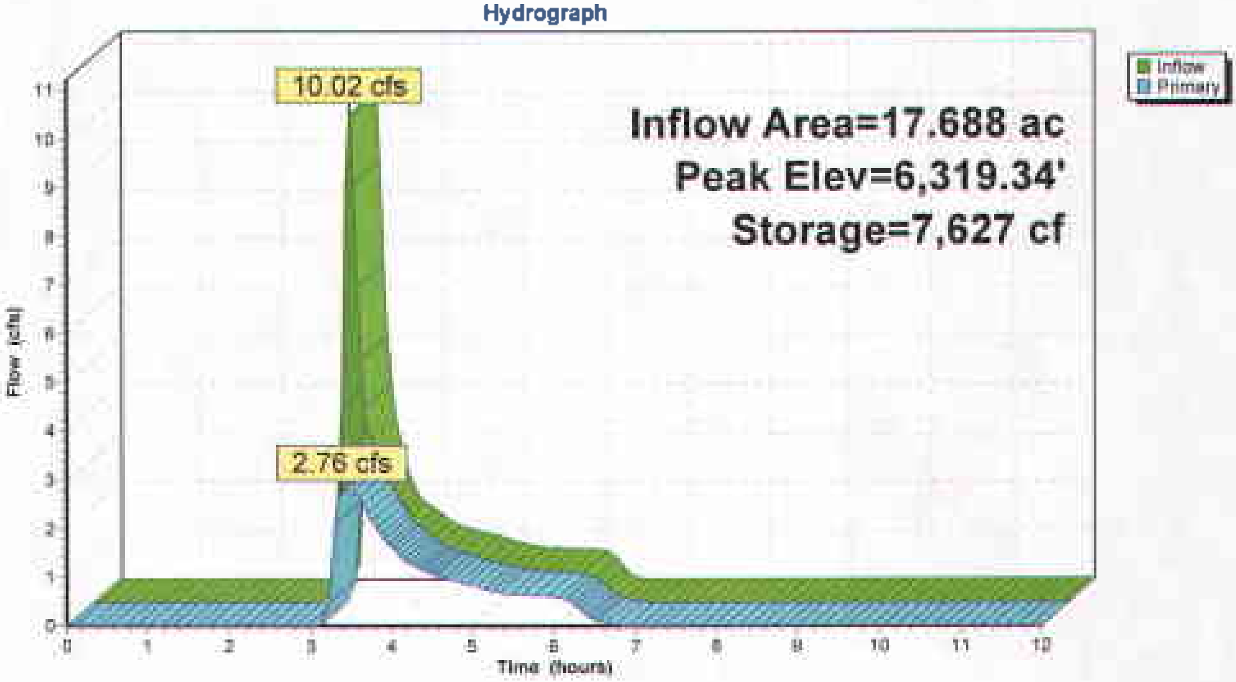
Volume	Invert	Avail.Storage	Storage Description
#1	6,309.00'	11,824 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,309.00	1,344	0.0	0	0
6,310.00	1,656	0.0	0	0
6,311.00	2,000	0.0	0	0
6,312.00	2,376	0.0	0	0
6,313.00	2,784	0.0	0	0
6,314.00	3,224	0.0	0	0
6,315.00	3,696	0.0	0	0
6,316.00	4,200	0.0	0	0
6,317.00	4,736	0.0	0	0
6,318.00	5,304	0.0	0	0
6,319.00	5,904	100.0	5,604	5,604
6,320.00	6,536	100.0	6,220	11,824

Device	Routing	Invert	Outlet Devices
#1	Primary	6,319.00'	**Special & User-Defined** Head (feet) 0.00 0.31 Disch. (cfs) 0.000 2.760

Primary OutFlow Max=2.76 cfs @ 3.40 hrs HW=6,319.33' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 2.76 cfs)

Pond WP2: WP #2

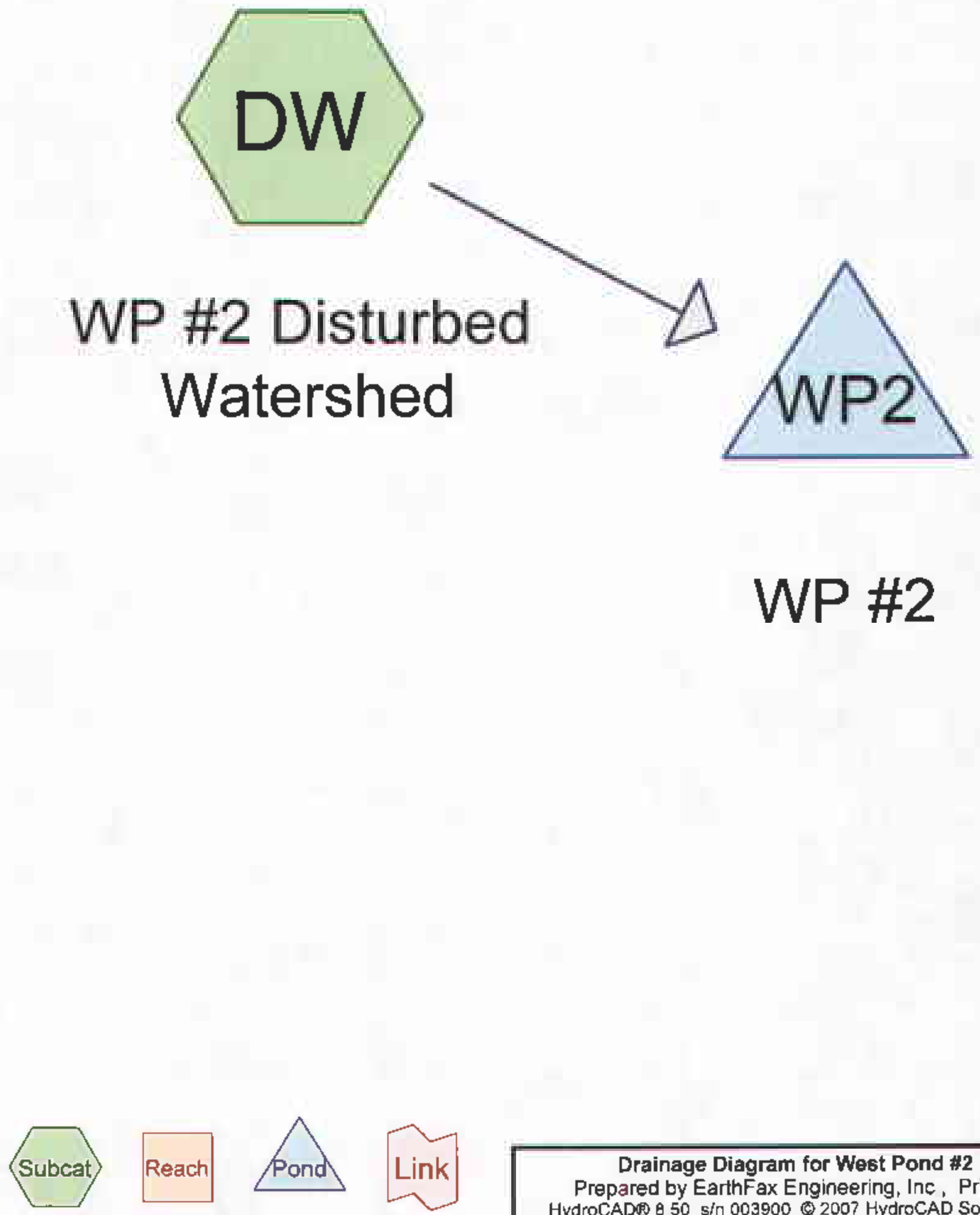

Hydrograph
10.02 cfs
2.76 cfs
Inflow Area=17.688 ac
Peak Elev=6,319.34'
Storage=7,627 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
11
12

West Pond #2 Spillway
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	West Pond #2 Spi
Flow Element	Trapezoidal Chan
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0 040	
Slope	100000	ft/ft
Left Side Slope	0 50	V : H
Right Side Slope	0 50	V : H
Bottom Width	1 00	ft
Discharge	2 76	cfs

Results		
Depth	0 36	ft
Flow Area	0 6	ft²
Wetted Perim	2 60	ft
Top Width	2 43	ft
Critical Depth	0 46	ft
Critical Slope	0 038025	ft/ft
Velocity	4 49	ft/s
Velocity Head	0 31	ft
Specific Energ	0 67	ft
Froude Numb	1 57	
Flow Type	Supercritical	



Drainage Diagram for West Pond #2 100yr, 0.5hr
Prepared by EarthFax Engineering, Inc , Printed 5/13/2009
HydroCAD® 8 50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-5.00 hrs, dt=0.05 hrs, 101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentDW: WP #2 Disturbed Runoff Area=17.920 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=2,014' Slope=0.1740 '/' Tc=12.5 min CN=82 Runoff=13.76 cfs 0.313 af

Pond WP2: WP #2 Peak Elev=6,314.74' Storage=13,629 cf Inflow=13.76 cfs 0.313 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 17.920 ac Runoff Volume = 0.313 af Average Runoff Depth = 0.21"
100.00% Pervious = 17.920 ac 0.00% Impervious = 0.000 ac

Summary for Pond WP2: WP #2

Inflow Area = 17.920 ac, 0.00% Impervious, Inflow Depth = 0.21"
Inflow = 13.76 cfs @ 0.44 hrs, Volume= 0.313 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-5.00 hrs, dt= 0.05 hrs
Peak Elev= 6,314.74' @ 1.25 hrs Surf.Area= 3,575 sf Storage= 13,629 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

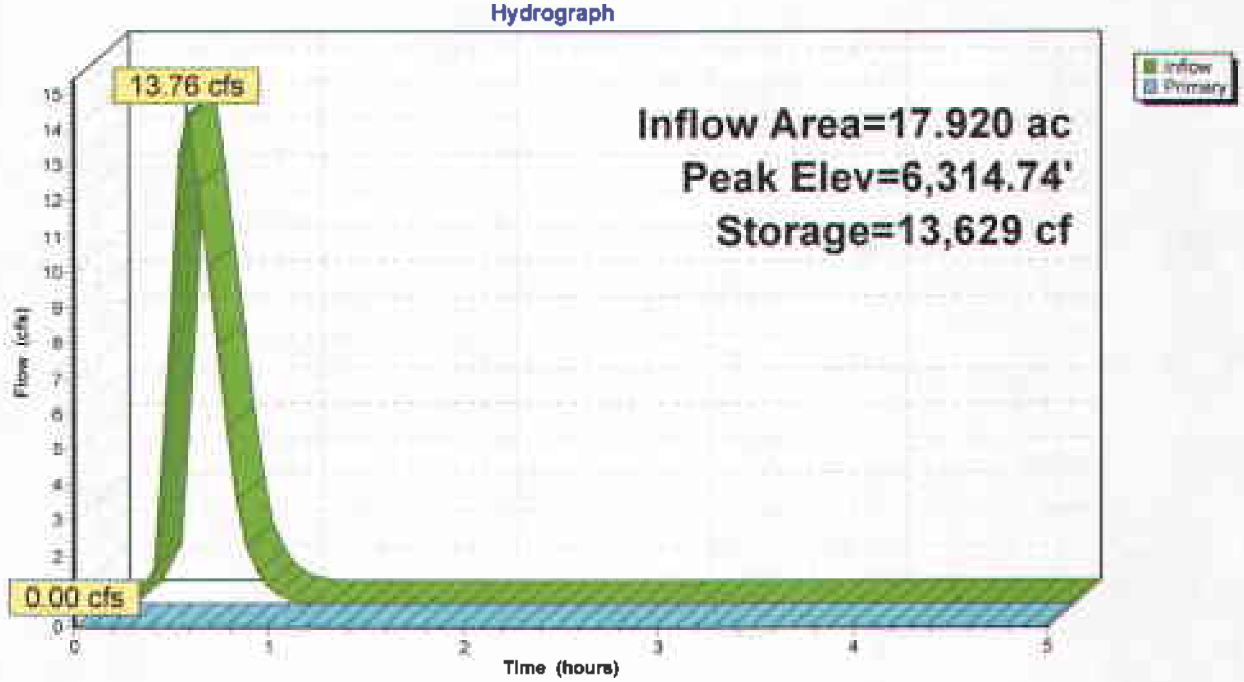
Volume	Invert	Avail.Storage	Storage Description
#1	6,309.00'	39,820 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

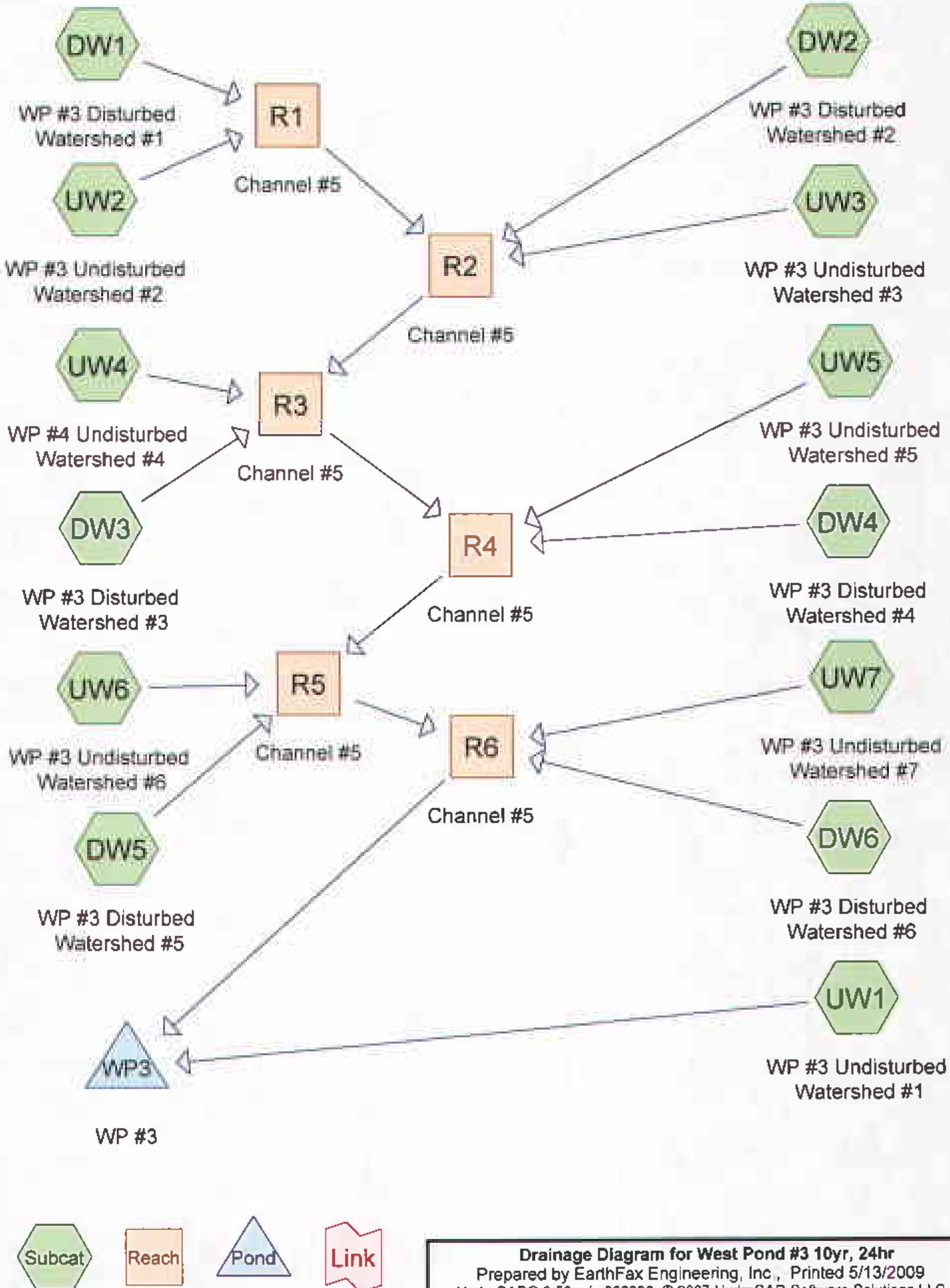
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6,309.00	1,344	0	0
6,310.00	1,656	1,500	1,500
6,311.00	2,000	1,828	3,328
6,312.00	2,376	2,188	5,516
6,313.00	2,784	2,580	8,096
6,314.00	3,224	3,004	11,100
6,315.00	3,696	3,460	14,560
6,316.00	4,200	3,948	18,508
6,317.00	4,736	4,468	22,976
6,318.00	5,304	5,020	27,996
6,319.00	5,904	5,604	33,600
6,320.00	6,536	6,220	39,820

Device	Routing	Invert	Outlet Devices
#1	Primary	6,319.00'	**Special & User-Defined** Head (feet) 0.00 0.31 Disch. (cfs) 0.000 2.760

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=6,309.00' (Free Discharge)
└─**1=Special & User-Defined** (Controls 0.00 cfs)

Pond WP2: WP #2


Hydrograph
13.76 cfs
0.00 cfs
Inflow
Primary
Inflow Area=17.920 ac
Peak Elev=6,314.74'
Storage=13,629 cf
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15



Drainage Diagram for West Pond #3 10yr, 24hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW1: WP #3 Disturbed Runoff Area=0.464 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=517' Slope=0.1550 '/' Tc=4.5 min CN=82 Runoff=0.42 cfs 0.019 af

Subcatchment DW2: WP #3 Disturbed Runoff Area=0.522 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=609' Slope=0.0900 '/' Tc=6.7 min CN=82 Runoff=0.43 cfs 0.021 af

Subcatchment DW3: WP #3 Disturbed Runoff Area=0.483 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=493' Slope=0.1320 '/' Tc=4.7 min CN=82 Runoff=0.44 cfs 0.020 af

Subcatchment DW4: WP #3 Disturbed Runoff Area=0.561 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=493' Slope=0.1520 '/' Tc=4.3 min CN=82 Runoff=0.52 cfs 0.023 af

Subcatchment DW5: WP #3 Disturbed Runoff Area=0.695 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=694' Slope=0.1510 '/' Tc=5.7 min CN=82 Runoff=0.60 cfs 0.028 af

Subcatchment DW6: WP #3 Disturbed Runoff Area=1.469 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=862' Slope=0.1040 '/' Tc=8.2 min CN=82 Runoff=1.15 cfs 0.060 af

Subcatchment UW1: WP #3 Undisturbed Runoff Area=0.186 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=298' Slope=0.3560 '/' Tc=2.9 min CN=67 Runoff=0.01 cfs 0.002 af

Subcatchment UW2: WP #3 Undisturbed Runoff Area=3.004 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=467' Slope=0.4820 '/' Tc=3.6 min CN=67 Runoff=0.20 cfs 0.026 af

Subcatchment UW3: WP #3 Undisturbed Runoff Area=2.220 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=354' Slope=0.3810 '/' Tc=3.2 min CN=67 Runoff=0.15 cfs 0.019 af

Subcatchment UW4: WP #4 Undisturbed Runoff Area=1.850 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=322' Slope=0.4970 '/' Tc=2.6 min CN=67 Runoff=0.13 cfs 0.016 af

Subcatchment UW5: WP #3 Undisturbed Runoff Area=1.516 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=337' Slope=0.4010 '/' Tc=3.0 min CN=67 Runoff=0.11 cfs 0.013 af

Subcatchment UW6: WP #3 Undisturbed Runoff Area=3.927 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=489' Slope=0.4090 '/' Tc=4.1 min CN=67 Runoff=0.25 cfs 0.034 af

Subcatchment UW7: WP #3 Undisturbed Runoff Area=5.022 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=585' Slope=0.4440 '/' Tc=4.5 min CN=67 Runoff=0.31 cfs 0.043 af

Reach R1: Channel #5 Avg. Depth=0.24' Max Vel=4.60 fps Inflow=0.59 cfs 0.045 af
n=0.022 L=609.0' S=0.0903 '/' Capacity=11.02 cfs Outflow=0.53 cfs 0.045 af

Reach R2: Channel #5 Avg. Depth=0.28' Max Vel=6.17 fps Inflow=1.02 cfs 0.085 af
n=0.022 L=493.0' S=0.1308 '/' Capacity=13.27 cfs Outflow=0.99 cfs 0.085 af

Reach R3: Channel #5 Avg. Depth=0.30' Max Vel=6.94 fps Inflow=1.30 cfs 0.121 af
n=0.022 L=493.0' S=0.1511 '/' Capacity=16.94 cfs Outflow=1.28 cfs 0.121 af

Reach R4: Channel #5 Avg. Depth=0.33' Max Vel=7.28 fps Inflow=1.60 cfs 0.157 af
n=0.022 L=694.0' S=0.1506 '/' Capacity=19.87 cfs Outflow=1.56 cfs 0.157 af

Reach R5: Channel #5 Avg. Depth=0.39' Max Vel=6.76 fps Inflow=2.11 cfs 0.219 af
n=0.022 L=862.0' S=0.1038 '/' Capacity=19.22 cfs Outflow=2.02 cfs 0.219 af

Reach R6: Channel #5 Avg. Depth=0.40' Max Vel=9.49 fps Inflow=3.02 cfs 0.322 af
n=0.022 L=282.0' S=0.1968 '/' Capacity=26.46 cfs Outflow=3.01 cfs 0.322 af

Pond WP3: WP #3 Peak Elev=5,731.63' Storage=14,078 cf Inflow=3.02 cfs 0.323 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 21.919 ac Runoff Volume = 0.323 af Average Runoff Depth = 0.18"
100.00% Pervious = 21.919 ac 0.00% Impervious = 0.000 ac

Summary for Reach R1: Channel #5

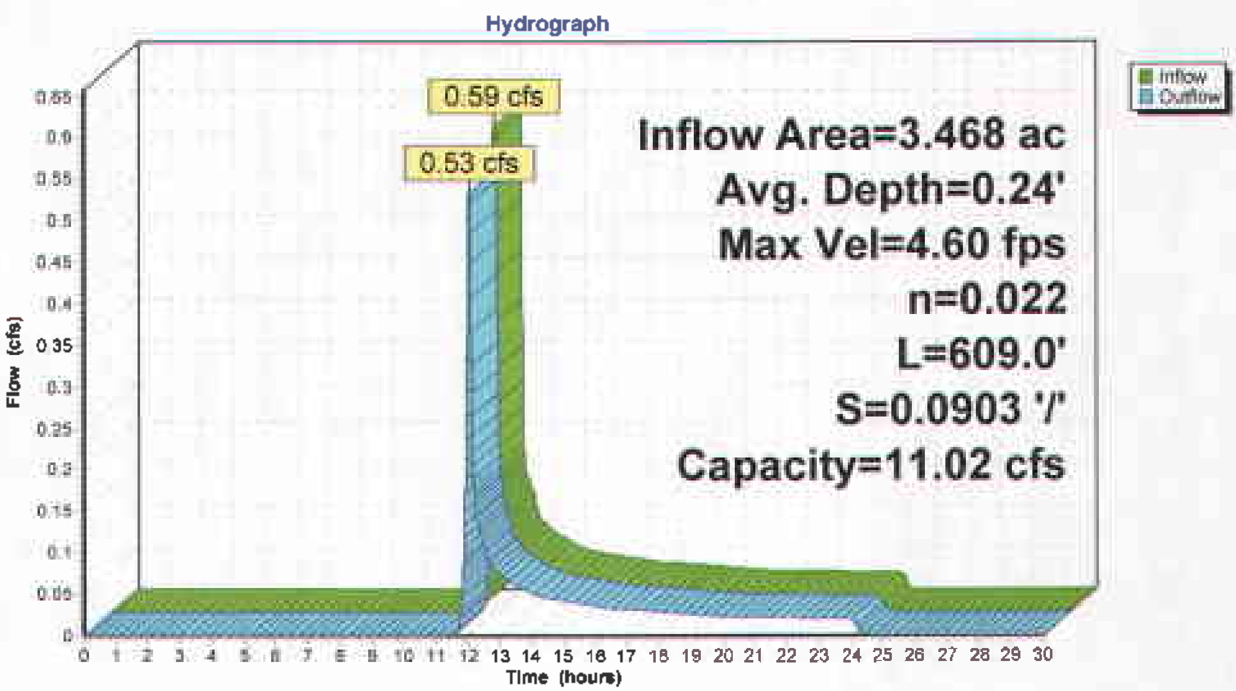
Inflow Area = 3.468 ac, 0.00% Impervious, Inflow Depth = 0.15"
Inflow = 0.59 cfs @ 11.98 hrs, Volume= 0.045 af
Outflow = 0.53 cfs @ 12.04 hrs, Volume= 0.045 af, Atten= 9%, Lag= 3.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.60 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 2.21 fps, Avg. Travel Time= 4.6 min

Peak Storage= 71 cf @ 12.01 hrs, Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 11.02 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 609.0' Slope= 0.0903 '/'
Inlet Invert= 6,180.00', Outlet Invert= 6,125.00'

Reach R1: Channel #5



Summary for Reach R2: Channel #5

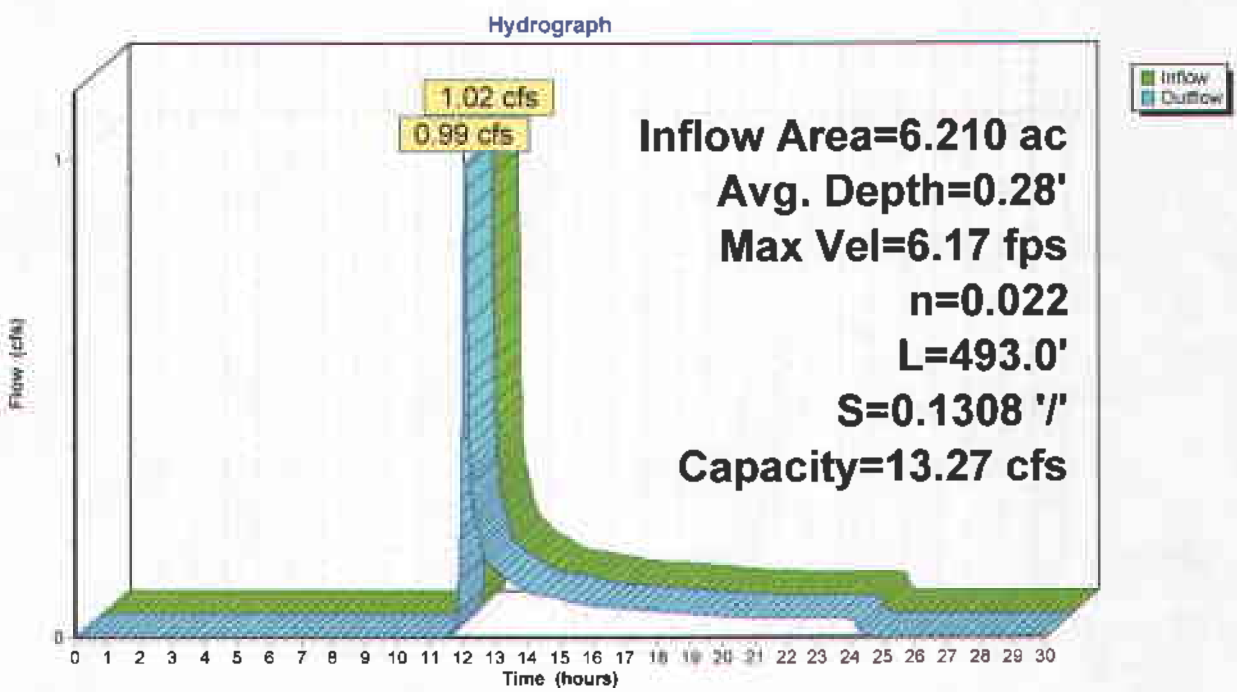
Inflow Area =	6.210 ac,	0.00% Impervious, Inflow Depth = 0.16"	
Inflow =	1.02 cfs @	12.02 hrs, Volume=	0.085 af
Outflow =	0.99 cfs @	12.05 hrs, Volume=	0.085 af, Atten= 3%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.17 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 2.93 fps, Avg. Travel Time= 2.8 min

Peak Storage= 80 cf @ 12.03 hrs, Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 13.27 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 493.0' Slope= 0.1308 '/'
Inlet Invert= 6,124.50', Outlet Invert= 6,060.00'

Reach R2: Channel #5



Summary for Reach R3: Channel #5

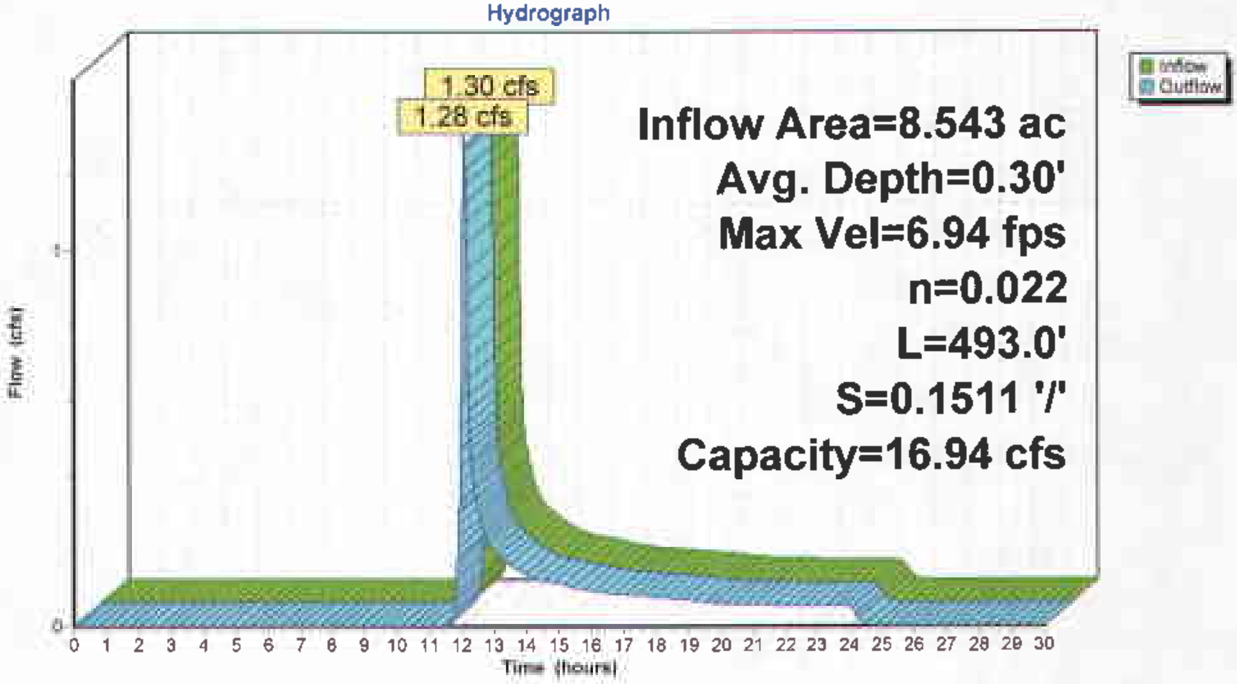
Inflow Area = 8.543 ac, 0.00% Impervious, Inflow Depth = 0.17"
Inflow = 1.30 cfs @ 12.02 hrs, Volume= 0.121 af
Outflow = 1.28 cfs @ 12.06 hrs, Volume= 0.121 af, Atten= 1%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.94 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 3.34 fps, Avg. Travel Time= 2.5 min

Peak Storage= 91 cf @ 12.04 hrs, Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 0.80', Capacity at Bank-Full= 16.94 cfs

0.00' x 0.80' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.20'
Length= 493.0' Slope= 0.1511 '/'
Inlet Invert= 6,059.50', Outlet Invert= 5,985.00'

Reach R3: Channel #5



Summary for Reach R4: Channel #5

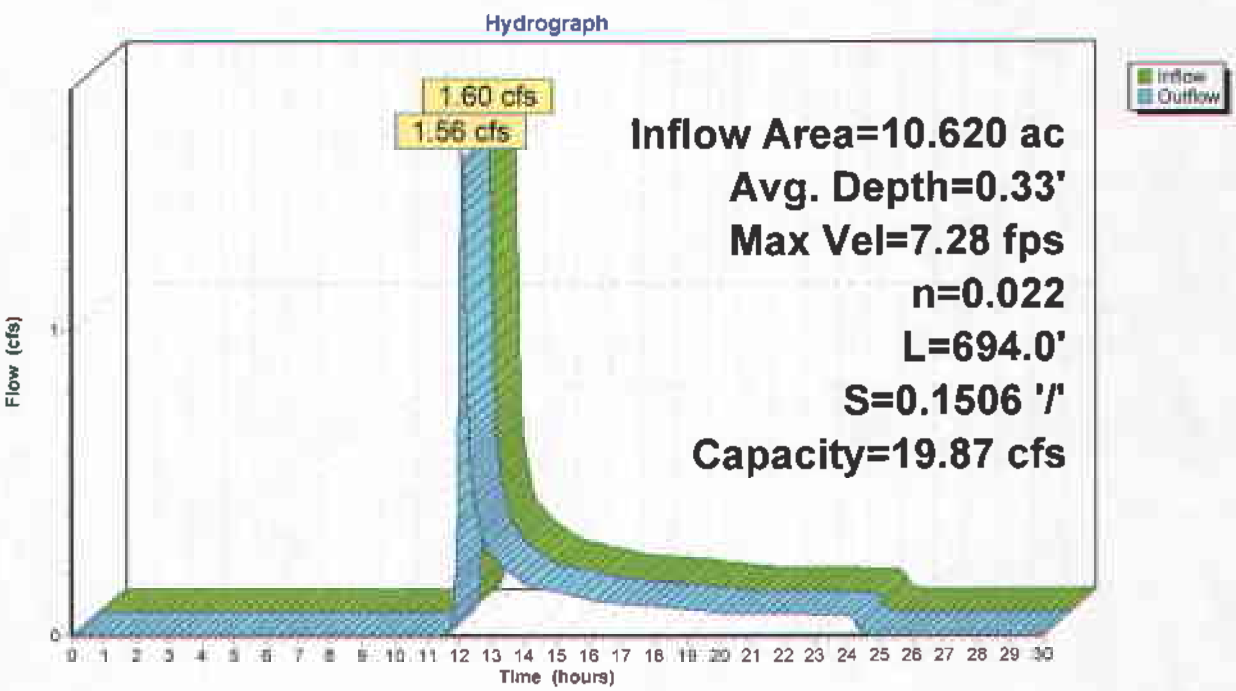
Inflow Area = 10.620 ac, 0.00% Impervious, Inflow Depth = 0.18"
Inflow = 1.60 cfs @ 12.02 hrs, Volume= 0.157 af
Outflow = 1.56 cfs @ 12.07 hrs, Volume= 0.157 af, Atten= 2%, Lag= 2.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.28 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 3.49 fps, Avg. Travel Time= 3.3 min

Peak Storage= 149 cf @ 12.04 hrs, Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 0.85', Capacity at Bank-Full= 19.87 cfs

0.00' x 0.85' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.40'
Length= 694.0' Slope= 0.1506 '/'
Inlet Invert= 5,984.50', Outlet Invert= 5,880.00'

Reach R4: Channel #5



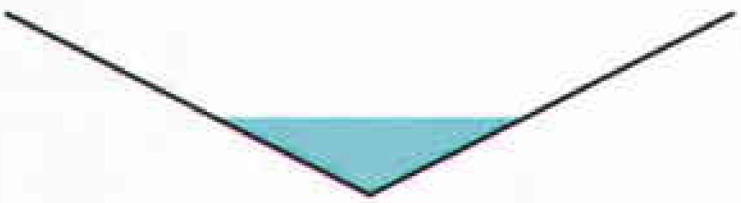
Summary for Reach R5: Channel #5

Inflow Area =	15.242 ac,	0.00% Impervious, Inflow Depth =	0.17"
Inflow =	2.11 cfs @	12.03 hrs, Volume=	0.219 af
Outflow =	2.02 cfs @	12.09 hrs, Volume=	0.219 af, Atten= 4%, Lag= 4.0 min

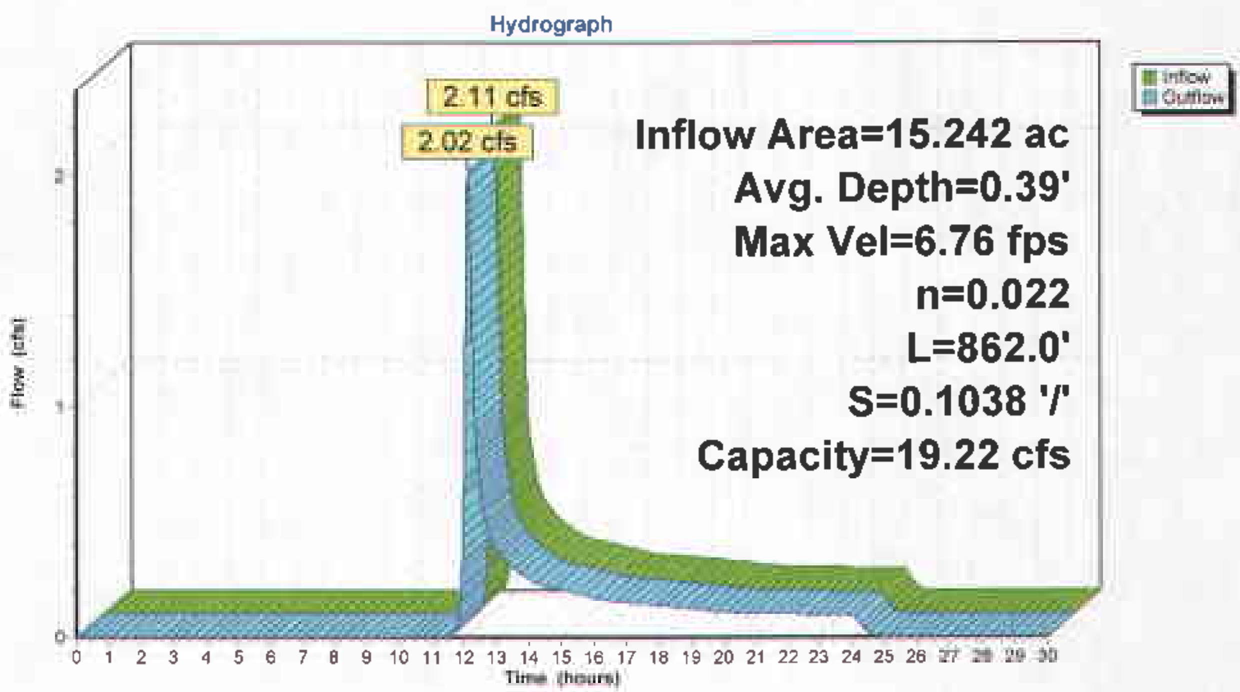
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.76 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 3.21 fps, Avg. Travel Time= 4.5 min

Peak Storage= 258 cf @ 12.06 hrs, Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 0.90', Capacity at Bank-Full= 19.22 cfs

0.00' x 0.90' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.60'
Length= 862.0' Slope= 0.1038 '/'
Inlet Invert= 5,879.50', Outlet Invert= 5,790.00'



Reach R5: Channel #5



Summary for Reach R6: Channel #5

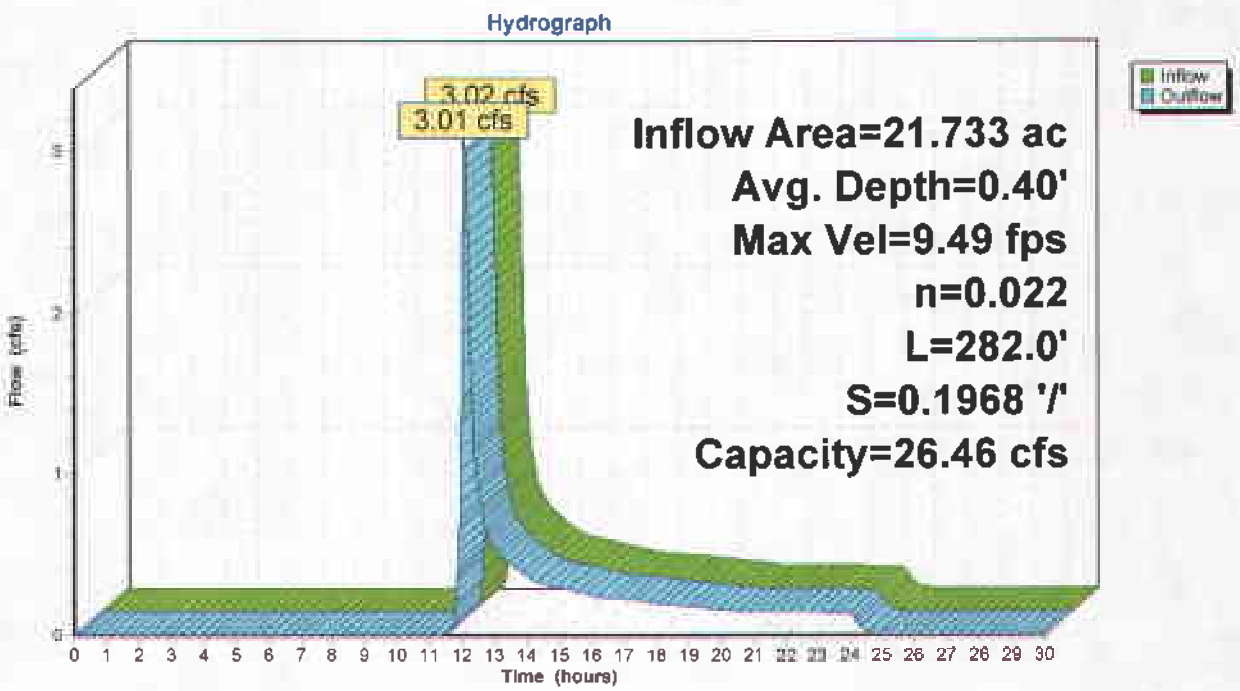
Inflow Area = 21.733 ac, 0.00% Impervious, Inflow Depth = 0.18"
Inflow = 3.02 cfs @ 12.05 hrs, Volume= 0.322 af
Outflow = 3.01 cfs @ 12.07 hrs, Volume= 0.322 af, Atten= 0%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.49 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 4.50 fps, Avg. Travel Time= 1.0 min

Peak Storage= 90 cf @ 12.06 hrs, Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 0.90', Capacity at Bank-Full= 26.46 cfs

0.00' x 0.90' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.60'
Length= 282.0' Slope= 0.1968 '/'
Inlet Invert= 5,789.50', Outlet Invert= 5,734.00'

Reach R6: Channel #5



Summary for Pond WP3: WP #3

Inflow Area = 21.919 ac, 0.00% Impervious, Inflow Depth = 0.18"
Inflow = 3.02 cfs @ 12.07 hrs, Volume= 0.323 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 5,731.63' @ 30.00 hrs Surf.Area= 2,860 sf Storage= 14,078 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

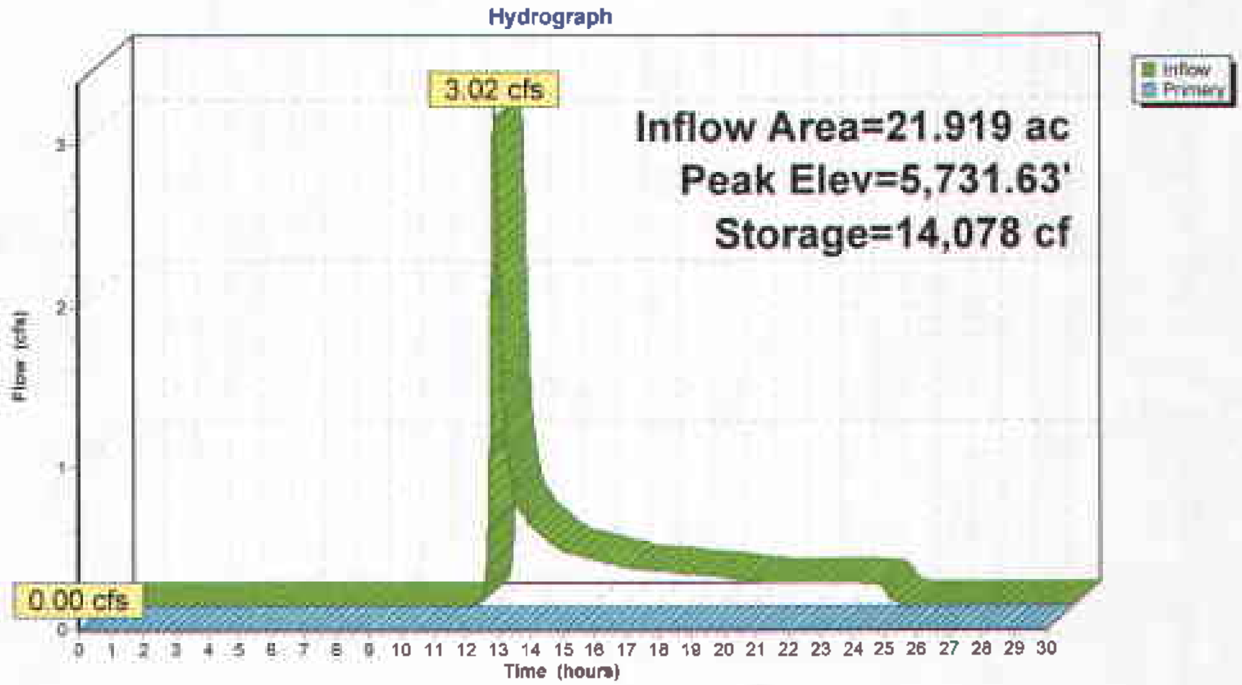
Volume	Invert	Avail.Storage	Storage Description
#1	5,721.00'	21,948 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

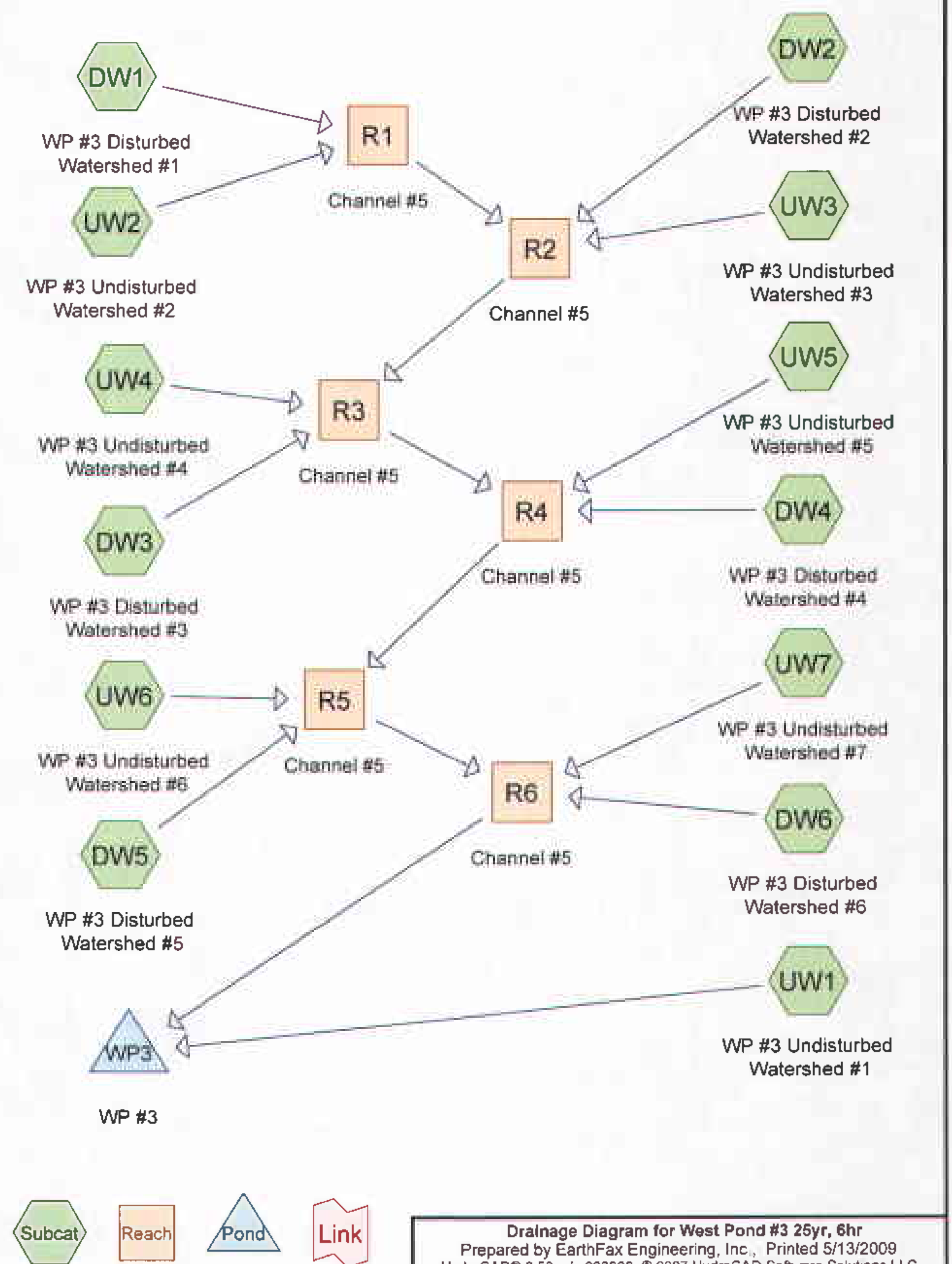
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,721.00	246	0	0
5,722.00	374	310	310
5,723.00	527	451	761
5,724.00	704	616	1,376
5,725.00	905	805	2,181
5,726.00	1,131	1,018	3,199
5,727.00	1,381	1,256	4,455
5,728.00	1,655	1,518	5,973
5,729.00	1,953	1,804	7,777
5,730.00	2,277	2,115	9,892
5,731.00	2,624	2,451	12,342
5,732.00	2,996	2,810	15,152
5,733.00	3,392	3,194	18,346
5,734.00	3,812	3,602	21,948

Device	Routing	Invert	Outlet Devices
#1	Primary	5,732.00'	**Special & User-Defined** Head (feet) 0.00 0.27 Disch. (cfs) 0.000 1.360

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5,721.00' (Free Discharge)
└─**1=Special & User-Defined** (Controls 0.00 cfs)

Pond WP3: WP #3


Hydrograph
3.02 cfs
Inflow Area=21.919 ac
Peak Elev=5,731.63'
Storage=14,078 cf
0.00 cfs
Inflow
Primary
Flow (cfs)
0
1
2
3
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Time (hours)



Drainage Diagram for West Pond #3 25yr, 6hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-12.00 hrs, dt=0.01 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW1: WP #3 Disturbed Runoff Area=0.464 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=517' Slope=0.1550 '/' Tc=4.5 min CN=82 Runoff=0.55 cfs 0.012 af

Subcatchment DW2: WP #3 Disturbed Runoff Area=0.522 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=609' Slope=0.0900 '/' Tc=6.7 min CN=82 Runoff=0.47 cfs 0.013 af

Subcatchment DW3: WP #3 Disturbed Runoff Area=0.483 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=493' Slope=0.1320 '/' Tc=4.7 min CN=82 Runoff=0.55 cfs 0.012 af

Subcatchment DW4: WP #3 Disturbed Runoff Area=0.561 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=493' Slope=0.1520 '/' Tc=4.3 min CN=82 Runoff=0.68 cfs 0.014 af

Subcatchment DW5: WP #3 Disturbed Runoff Area=0.695 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=694' Slope=0.1510 '/' Tc=5.7 min CN=82 Runoff=0.70 cfs 0.017 af

Subcatchment DW6: WP #3 Disturbed Runoff Area=1.469 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=862' Slope=0.1040 '/' Tc=8.2 min CN=82 Runoff=1.14 cfs 0.036 af

Subcatchment UW1: WP #3 Undisturbed Runoff Area=0.186 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=298' Slope=0.3560 '/' Tc=2.9 min CN=67 Runoff=0.00 cfs 0.001 af

Subcatchment UW2: WP #3 Undisturbed Runoff Area=3.004 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=467' Slope=0.4820 '/' Tc=3.6 min CN=67 Runoff=0.04 cfs 0.008 af

Subcatchment UW3: WP #3 Undisturbed Runoff Area=2.220 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=354' Slope=0.3810 '/' Tc=3.2 min CN=67 Runoff=0.03 cfs 0.006 af

Subcatchment UW4: WP #3 Undisturbed Runoff Area=1.850 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=322' Slope=0.4970 '/' Tc=2.6 min CN=67 Runoff=0.03 cfs 0.005 af

Subcatchment UW5: WP #3 Undisturbed Runoff Area=1.516 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=337' Slope=0.4010 '/' Tc=3.0 min CN=67 Runoff=0.02 cfs 0.004 af

Subcatchment UW6: WP #3 Undisturbed Runoff Area=3.927 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=489' Slope=0.4090 '/' Tc=4.1 min CN=67 Runoff=0.06 cfs 0.011 af

Subcatchment UW7: WP #3 Undisturbed Runoff Area=5.022 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=585' Slope=0.4440 '/' Tc=4.5 min CN=67 Runoff=0.07 cfs 0.014 af

Reach R1: Channel #5 Avg. Depth=0.22' Max Vel=4.32 fps Inflow=0.55 cfs 0.020 af
n=0.022 L=609.0' S=0.0903 '/' Capacity=11.02 cfs Outflow=0.41 cfs 0.020 af

Reach R2: Channel #5 Avg. Depth=0.26' Max Vel=5.77 fps Inflow=0.81 cfs 0.039 af
n=0.022 L=493.0' S=0.1308 '/' Capacity=13.27 cfs Outflow=0.76 cfs 0.039 af

Reach R3: Channel #5 Avg. Depth=0.27' Max Vel=6.39 fps Inflow=0.95 cfs 0.056 af
n=0.022 L=493.0' S=0.1511 '/' Capacity=16.94 cfs Outflow=0.92 cfs 0.056 af

Reach R4: Channel #5 Avg. Depth=0.28' Max Vel=6.61 fps Inflow=1.09 cfs 0.075 af
n=0.022 L=694.0' S=0.1506 '/' Capacity=19.87 cfs Outflow=1.06 cfs 0.075 af

Reach R5: Channel #5 Avg. Depth=0.32' Max Vel=5.99 fps Inflow=1.28 cfs 0.103 af
n=0.022 L=862.0' S=0.1038 '/' Capacity=19.22 cfs Outflow=1.25 cfs 0.103 af

Reach R6: Channel #5 Avg. Depth=0.34' Max Vel=8.47 fps Inflow=1.92 cfs 0.153 af
n=0.022 L=282.0' S=0.1968 '/' Capacity=26.46 cfs Outflow=1.91 cfs 0.153 af

Pond WP3: WP #3 Peak Elev=5,732.27' Storage=825 cf Inflow=1.92 cfs 0.154 af
Outflow=1.36 cfs 0.154 af

Total Runoff Area = 21.919 ac Runoff Volume = 0.154 af Average Runoff Depth = 0.08"
100.00% Pervious = 21.919 ac 0.00% Impervious = 0.000 ac

Summary for Reach R1: Channel #5

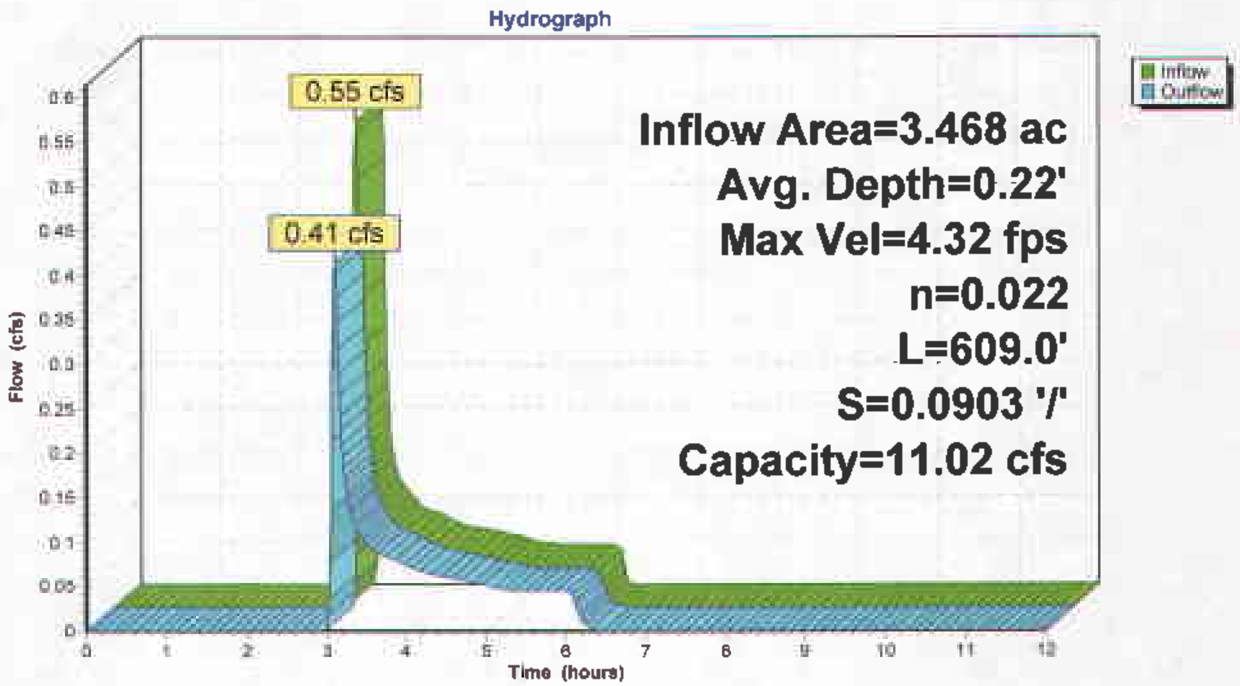
Inflow Area = 3.468 ac, 0.00% Impervious, Inflow Depth = 0.07"
Inflow = 0.55 cfs @ 3.03 hrs, Volume= 0.020 af
Outflow = 0.41 cfs @ 3.10 hrs, Volume= 0.020 af, Atten= 24%, Lag= 4.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.32 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 2.32 fps, Avg. Travel Time= 4.4 min

Peak Storage= 59 cf @ 3.06 hrs, Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 11.02 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 609.0' Slope= 0.0903 '/'
Inlet Invert= 6,180.00', Outlet Invert= 6,125.00'

Reach R1: Channel #5



Summary for Reach R2: Channel #5

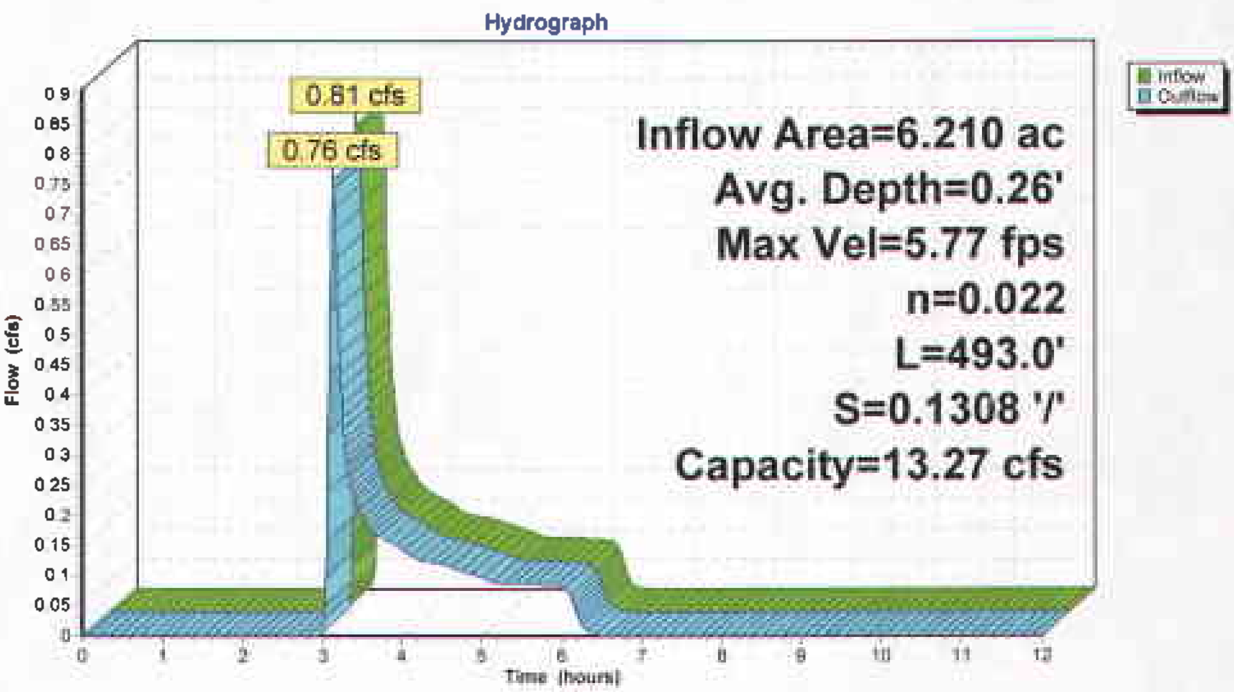
Inflow Area = 6.210 ac, 0.00% Impervious, Inflow Depth = 0.08"
Inflow = 0.81 cfs @ 3.09 hrs, Volume= 0.039 af
Outflow = 0.76 cfs @ 3.13 hrs, Volume= 0.039 af, Atten= 7%, Lag= 2.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.77 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 3.03 fps, Avg. Travel Time= 2.7 min

Peak Storage= 65 cf @ 3.11 hrs, Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 13.27 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 493.0' Slope= 0.1308 '/'
Inlet Invert= 6,124.50', Outlet Invert= 6,060.00'

Reach R2: Channel #5



Summary for Reach R3: Channel #5

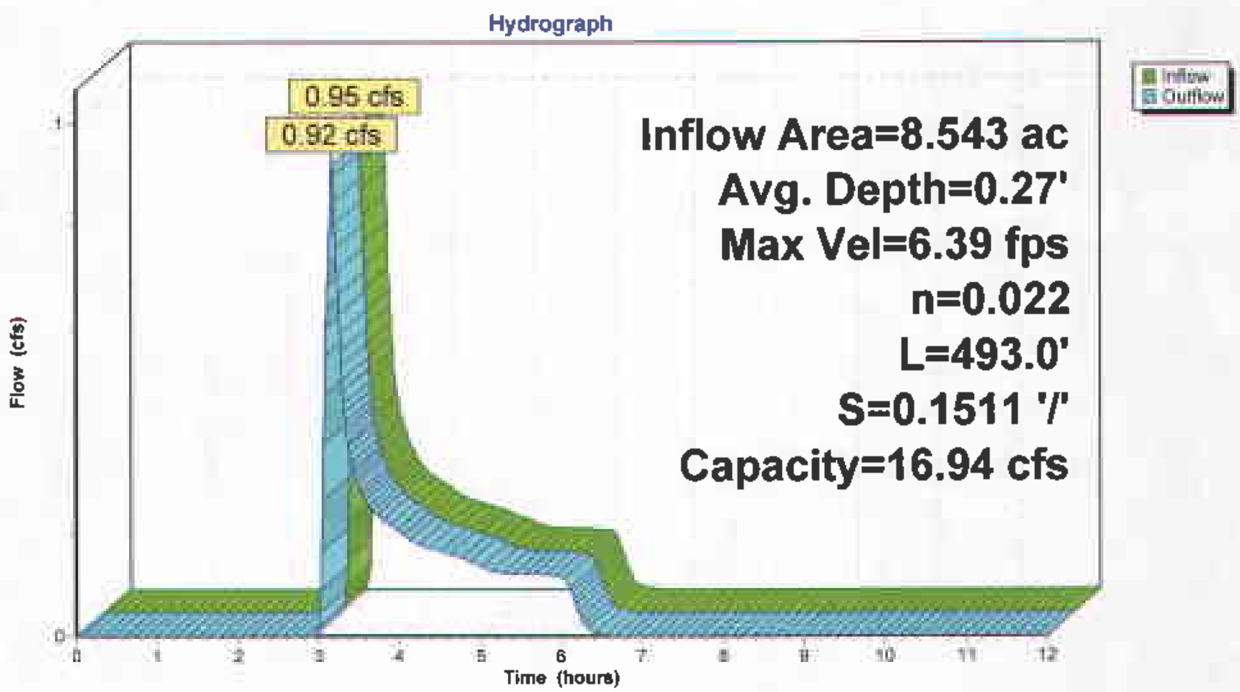
Inflow Area = 8.543 ac, 0.00% Impervious, Inflow Depth = 0.08"
Inflow = 0.95 cfs @ 3.12 hrs, Volume= 0.056 af
Outflow = 0.92 cfs @ 3.16 hrs, Volume= 0.056 af, Atten= 3%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.39 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 3.40 fps, Avg. Travel Time= 2.4 min

Peak Storage= 71 cf @ 3.14 hrs, Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 0.80', Capacity at Bank-Full= 16.94 cfs

0.00' x 0.80' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.20'
Length= 493.0' Slope= 0.1511 '/'
Inlet Invert= 6,059.50', Outlet Invert= 5,985.00'

Reach R3: Channel #5



Summary for Reach R4: Channel #5

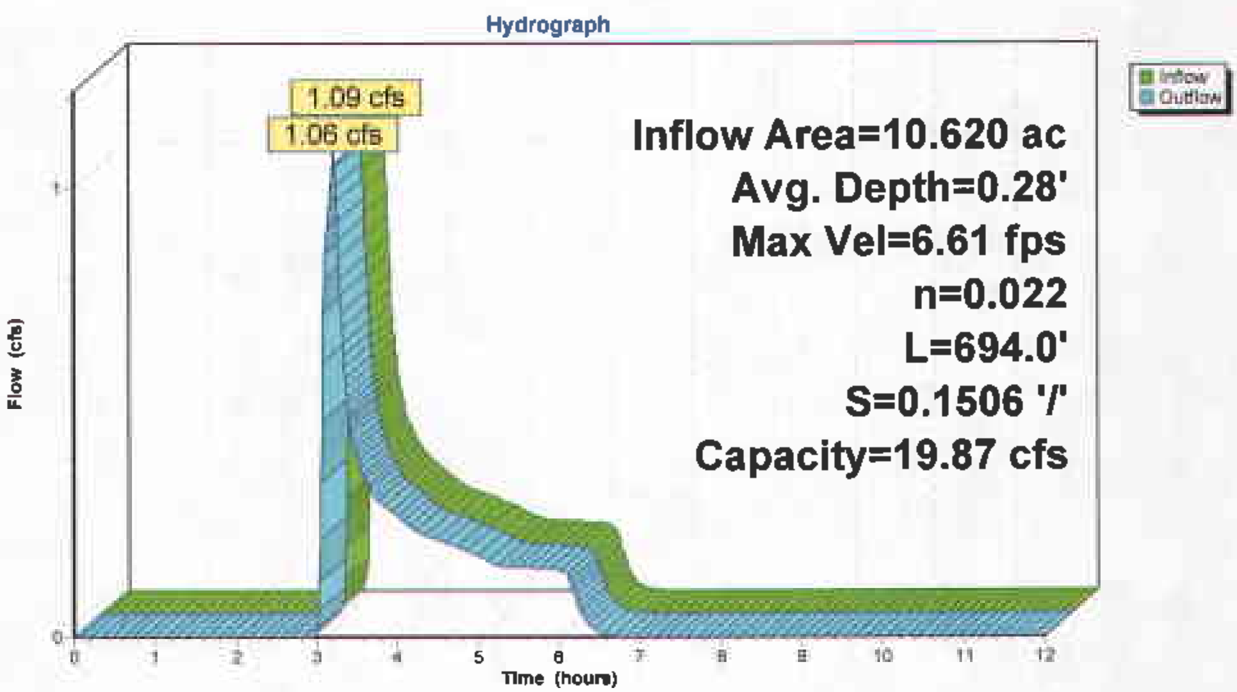
Inflow Area =	10.620 ac,	0.00% Impervious, Inflow Depth = 0.08"	
Inflow =	1.09 cfs @	3.16 hrs, Volume=	0.075 af
Outflow =	1.06 cfs @	3.20 hrs, Volume=	0.075 af, Atten= 3%, Lag= 2.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.61 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 3.46 fps, Avg. Travel Time= 3.3 min

Peak Storage= 111 cf @ 3.17 hrs, Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 0.85', Capacity at Bank-Full= 19.87 cfs

0.00' x 0.85' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.40'
Length= 694.0' Slope= 0.1506 '/'
Inlet Invert= 5,984.50', Outlet Invert= 5,880.00'

Reach R4: Channel #5



Summary for Reach R5: Channel #5

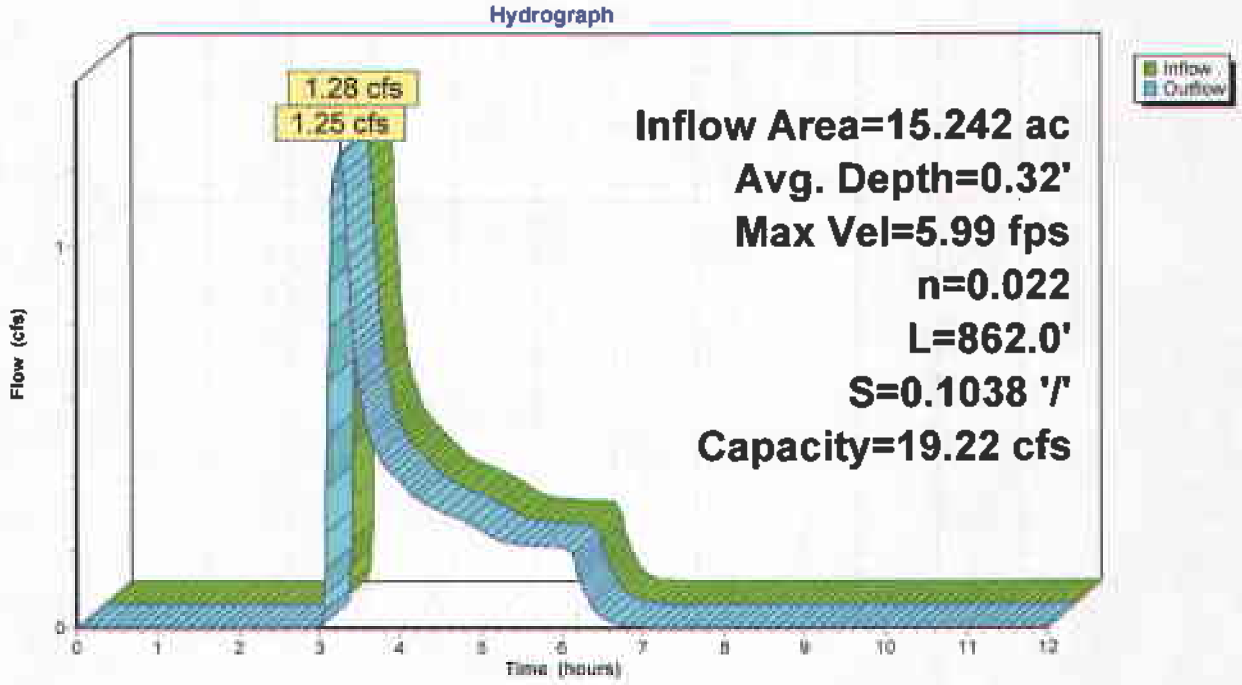
Inflow Area =	15.242 ac,	0.00% Impervious,	Inflow Depth = 0.08"	
Inflow =	1.28 cfs @	3.09 hrs, Volume=	0.103 af	
Outflow =	1.25 cfs @	3.25 hrs, Volume=	0.103 af,	Atten= 2%, Lag= 9.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.99 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 3.02 fps, Avg. Travel Time= 4.8 min

Peak Storage= 180 cf @ 3.21 hrs, Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 0.90', Capacity at Bank-Full= 19.22 cfs

0.00' x 0.90' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.60'
Length= 862.0' Slope= 0.1038 '/'
Inlet Invert= 5,879.50', Outlet Invert= 5,790.00'

Reach R5: Channel #5



Summary for Reach R6: Channel #5

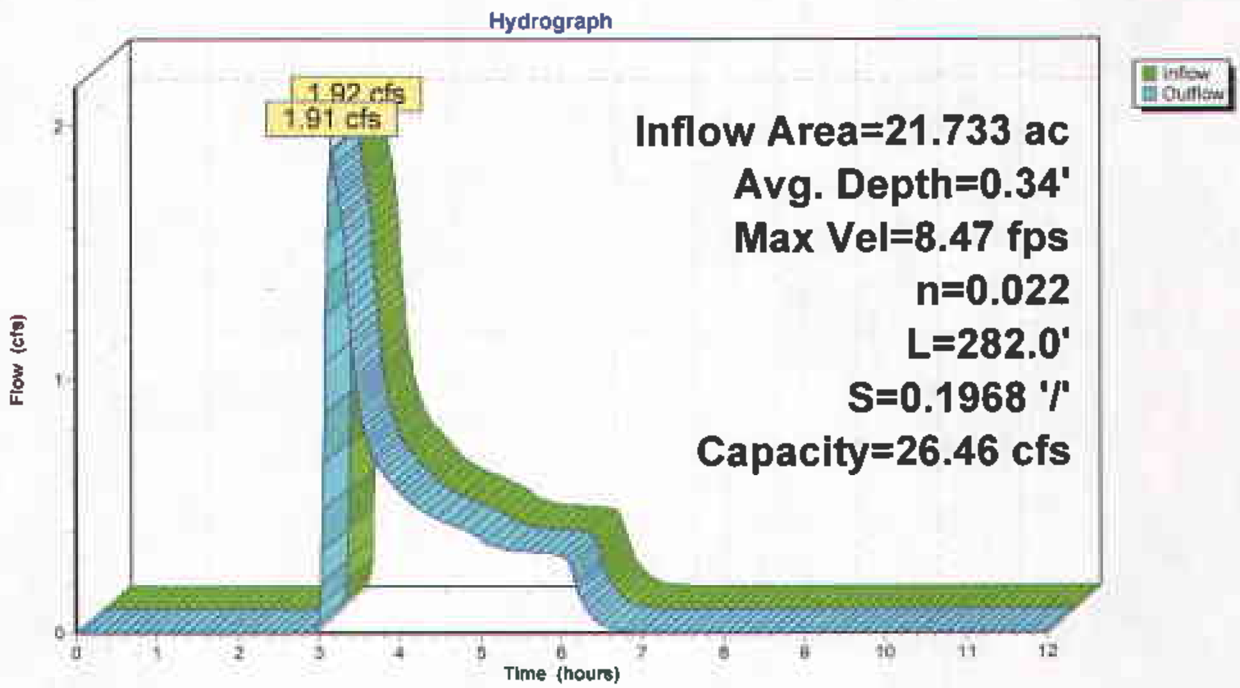
Inflow Area = 21.733 ac, 0.00% Impervious, Inflow Depth = 0.08"
Inflow = 1.92 cfs @ 3.14 hrs, Volume= 0.153 af
Outflow = 1.91 cfs @ 3.15 hrs, Volume= 0.153 af, Atten= 0%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.47 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 4.27 fps, Avg. Travel Time= 1.1 min

Peak Storage= 64 cf @ 3.14 hrs, Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 0.90', Capacity at Bank-Full= 26.46 cfs

0.00' x 0.90' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.60'
Length= 282.0' Slope= 0.1968 '/'
Inlet Invert= 5,789.50', Outlet Invert= 5,734.00'

Reach R6: Channel #5



Summary for Pond WP3: WP #3

Inflow Area = 21.919 ac, 0.00% Impervious, Inflow Depth = 0.08"
Inflow = 1.92 cfs @ 3.15 hrs, Volume= 0.154 af
Outflow = 1.36 cfs @ 3.35 hrs, Volume= 0.154 af, Atten= 29%, Lag= 11.8 min
Primary = 1.36 cfs @ 3.35 hrs, Volume= 0.154 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs
Peak Elev= 5,732.27' @ 3.35 hrs Surf.Area= 3,103 sf Storage= 825 cf

Plug-Flow detention time= 10.0 min calculated for 0.154 af (100% of inflow)
Center-of-Mass det. time= 10.0 min (259.4 - 249.4)

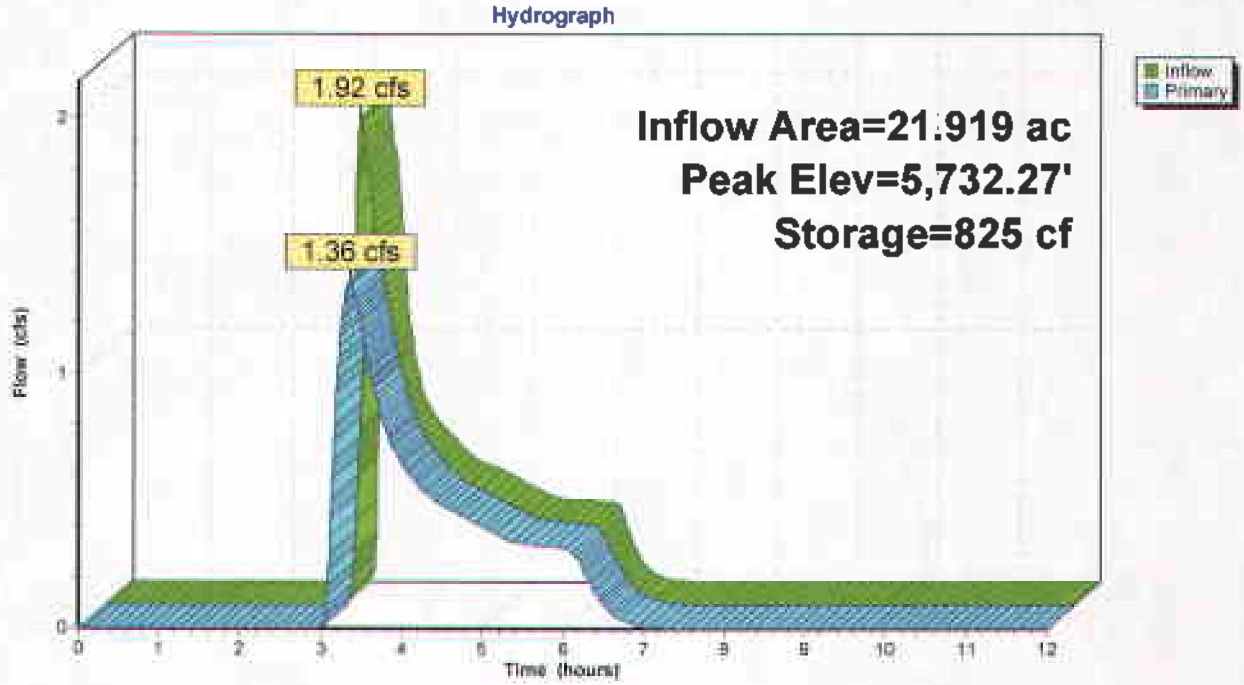
Volume	Invert	Avail.Storage	Storage Description
#1	5,721.00'	6,796 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,721.00	246	0.0	0	0
5,722.00	374	0.0	0	0
5,723.00	527	0.0	0	0
5,724.00	704	0.0	0	0
5,725.00	905	0.0	0	0
5,726.00	1,131	0.0	0	0
5,727.00	1,381	0.0	0	0
5,728.00	1,655	0.0	0	0
5,729.00	1,953	0.0	0	0
5,730.00	2,277	0.0	0	0
5,731.00	2,624	0.0	0	0
5,732.00	2,996	0.0	0	0
5,733.00	3,392	100.0	3,194	3,194
5,734.00	3,812	100.0	3,602	6,796

Device	Routing	Invert	Outlet Devices
#1	Primary	5,732.00'	**Special & User-Defined** Head (feet) 0.00 0.27 Disch. (cfs) 0.000 1.360

Primary OutFlow Max=1.36 cfs @ 3.35 hrs HW=5,732.27' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 1.36 cfs)

Pond WP3: WP #3


Hydrograph
1.92 cfs
1.36 cfs
Inflow Area=21.919 ac
Peak Elev=5,732.27'
Storage=825 cf
Inflow
Primary
Flow (cfs)
0
1
2
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
11
12

West Pond #4 Spillway Top
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	West Pond #4 Spillw:
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	056000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Bottom Width	1.00	ft
Discharge	3.00	cfs

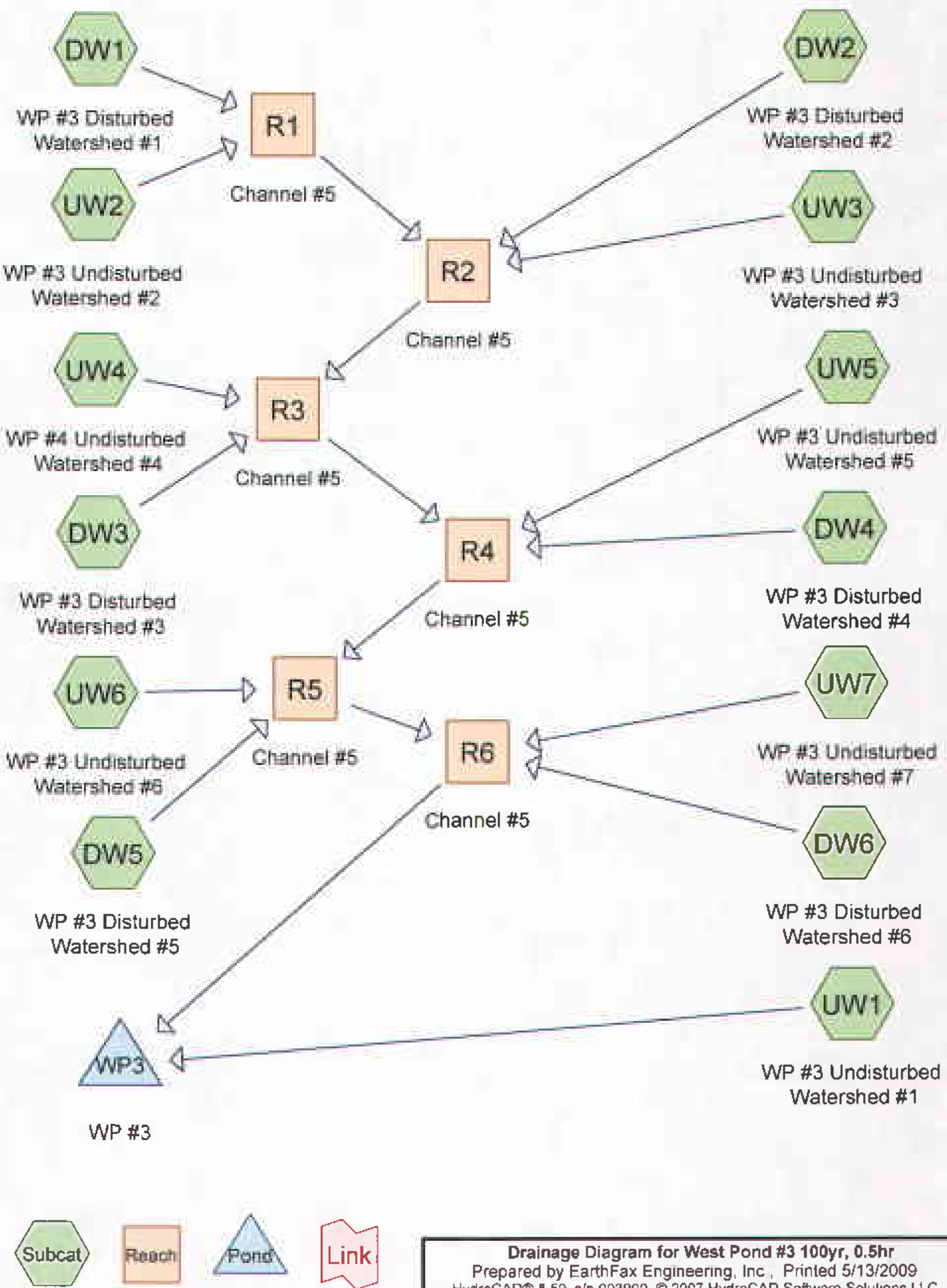
Results		
Depth	0.43	ft
Flow Area	0.8	ft²
Wetted Perim	2.93	ft
Top Width	2.73	ft
Critical Depth	0.48	ft
Critical Slope	0.037620	ft/ft
Velocity	3.72	ft/s
Velocity Head	0.21	ft
Specific Energ	0.65	ft
Froude Numb	1.21	
Flow Type	Supercritical	

West Pond #4 Spillway Bottom
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	West Pond #4 Spillway
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0 040	
Slope	333000	ft/ft
Left Side Slope	0 50	V : H
Right Side Slope	0 50	V : H
Bottom Width	1 00	ft
Discharge	3 00	cfs

Results		
Depth	0 27	ft
Flow Area	0 4	ft²
Wetted Perim	2 22	ft
Top Width	2 09	ft
Critical Depth	0 48	ft
Critical Slope	0 037620	ft/ft
Velocity	7 09	ft/s
Velocity Head	0 78	ft
Specific Energ	1 06	ft
Froude Numb	2 78	
Flow Type	Supercritical	



Drainage Diagram for West Pond #3 100yr, 0.5hr
Prepared by EarthFax Engineering, Inc , Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-5.00 hrs, dt=0.01 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW1: WP #3 Disturbed Runoff Area=0.464 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=517' Slope=0.1550 '/' Tc=4.5 min CN=82 Runoff=0.72 cfs 0.008 af

Subcatchment DW2: WP #3 Disturbed Runoff Area=0.522 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=609' Slope=0.0900 '/' Tc=6.7 min CN=82 Runoff=0.62 cfs 0.009 af

Subcatchment DW3: WP #3 Disturbed Runoff Area=0.483 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=493' Slope=0.1320 '/' Tc=4.7 min CN=82 Runoff=0.73 cfs 0.008 af

Subcatchment DW4: WP #3 Disturbed Runoff Area=0.561 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=493' Slope=0.1520 '/' Tc=4.3 min CN=82 Runoff=0.90 cfs 0.010 af

Subcatchment DW5: WP #3 Disturbed Runoff Area=0.695 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=694' Slope=0.1510 '/' Tc=5.7 min CN=82 Runoff=0.93 cfs 0.012 af

Subcatchment DW6: WP #3 Disturbed Runoff Area=1.469 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=862' Slope=0.1040 '/' Tc=8.2 min CN=82 Runoff=1.53 cfs 0.026 af

Subcatchment UW1: WP #3 Undisturbed Runoff Area=0.186 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=298' Slope=0.3560 '/' Tc=2.9 min CN=67 Runoff=0.01 cfs 0.000 af

Subcatchment UW2: WP #3 Undisturbed Runoff Area=3.004 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=467' Slope=0.4820 '/' Tc=3.6 min CN=67 Runoff=0.18 cfs 0.003 af

Subcatchment UW3: WP #3 Undisturbed Runoff Area=2.220 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=354' Slope=0.3810 '/' Tc=3.2 min CN=67 Runoff=0.13 cfs 0.002 af

Subcatchment UW4: WP #4 Undisturbed Runoff Area=1.850 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=322' Slope=0.4970 '/' Tc=2.6 min CN=67 Runoff=0.11 cfs 0.002 af

Subcatchment UW5: WP #3 Undisturbed Runoff Area=1.516 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=337' Slope=0.4010 '/' Tc=3.0 min CN=67 Runoff=0.09 cfs 0.001 af

Subcatchment UW6: WP #3 Undisturbed Runoff Area=3.927 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=489' Slope=0.4090 '/' Tc=4.1 min CN=67 Runoff=0.23 cfs 0.004 af

Subcatchment UW7: WP #3 Undisturbed Runoff Area=5.022 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=585' Slope=0.4440 '/' Tc=4.5 min CN=67 Runoff=0.29 cfs 0.005 af

Reach R1: Channel #5 Avg. Depth=0.25' Max Vel=4.70 fps Inflow=0.73 cfs 0.011 af
n=0.022 L=609.0' S=0.0903 '/' Capacity=11.02 cfs Outflow=0.58 cfs 0.011 af

Reach R2: Channel #5 Avg. Depth=0.30' Max Vel=6.42 fps Inflow=1.22 cfs 0.022 af
n=0.022 L=493.0' S=0.1308 '/' Capacity=13.27 cfs Outflow=1.17 cfs 0.022 af

Reach R3: Channel #5 Avg. Depth=0.33' Max Vel=7.27 fps Inflow=1.58 cfs 0.032 af
n=0.022 L=493.0' S=0.1511 '/' Capacity=16.94 cfs Outflow=1.54 cfs 0.032 af

Reach R4: Channel #5 Avg. Depth=0.35' Max Vel=7.60 fps Inflow=1.90 cfs 0.044 af
n=0.022 L=694.0' S=0.1506 '/' Capacity=19.87 cfs Outflow=1.85 cfs 0.044 af

Reach R5: Channel #5 Avg. Depth=0.41' Max Vel=7.01 fps Inflow=2.39 cfs 0.060 af
n=0.022 L=862.0' S=0.1036 '/' Capacity=19.22 cfs Outflow=2.34 cfs 0.060 af

Reach R6: Channel #5 Avg. Depth=0.41' Max Vel=9.71 fps Inflow=3.30 cfs 0.090 af
n=0.022 L=282.0' S=0.1968 '/' Capacity=26.46 cfs Outflow=3.30 cfs 0.090 af

Pond WP3: WP #3 Peak Elev=5,726.61' Storage=3,936 cf Inflow=3.31 cfs 0.090 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 21.919 ac Runoff Volume = 0.090 af Average Runoff Depth = 0.05"
100.00% Pervious = 21.919 ac 0.00% Impervious = 0.000 ac

Summary for Reach R1: Channel #5

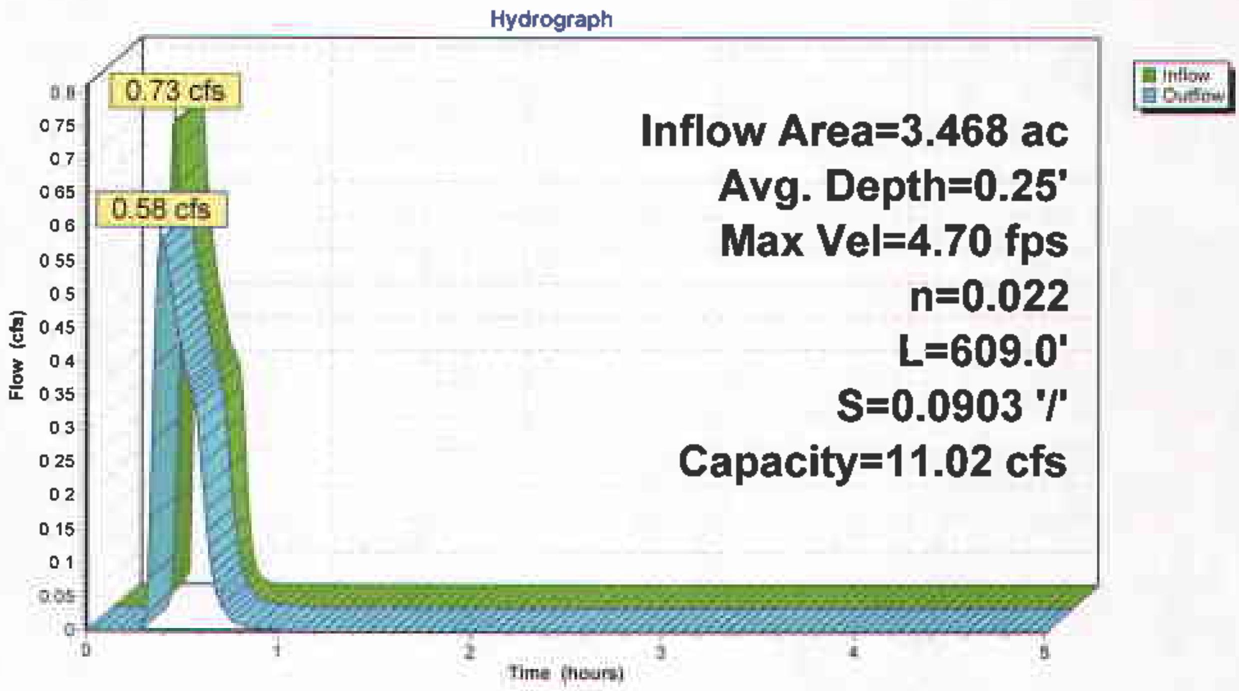
Inflow Area =	3.468 ac,	0.00% Impervious,	Inflow Depth =	0.04"	
Inflow =	0.73 cfs @	0.32 hrs,	Volume=	0.011 af	
Outflow =	0.58 cfs @	0.39 hrs,	Volume=	0.011 af,	Atten= 20%, Lag= 4.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.70 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 1.83 fps, Avg. Travel Time= 5.6 min

Peak Storage= 76 cf @ 0.35 hrs, Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 11.02 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 609.0' Slope= 0.0903 '/'
Inlet Invert= 6,180.00', Outlet Invert= 6,125.00'

Reach R1: Channel #5



Summary for Reach R2: Channel #5

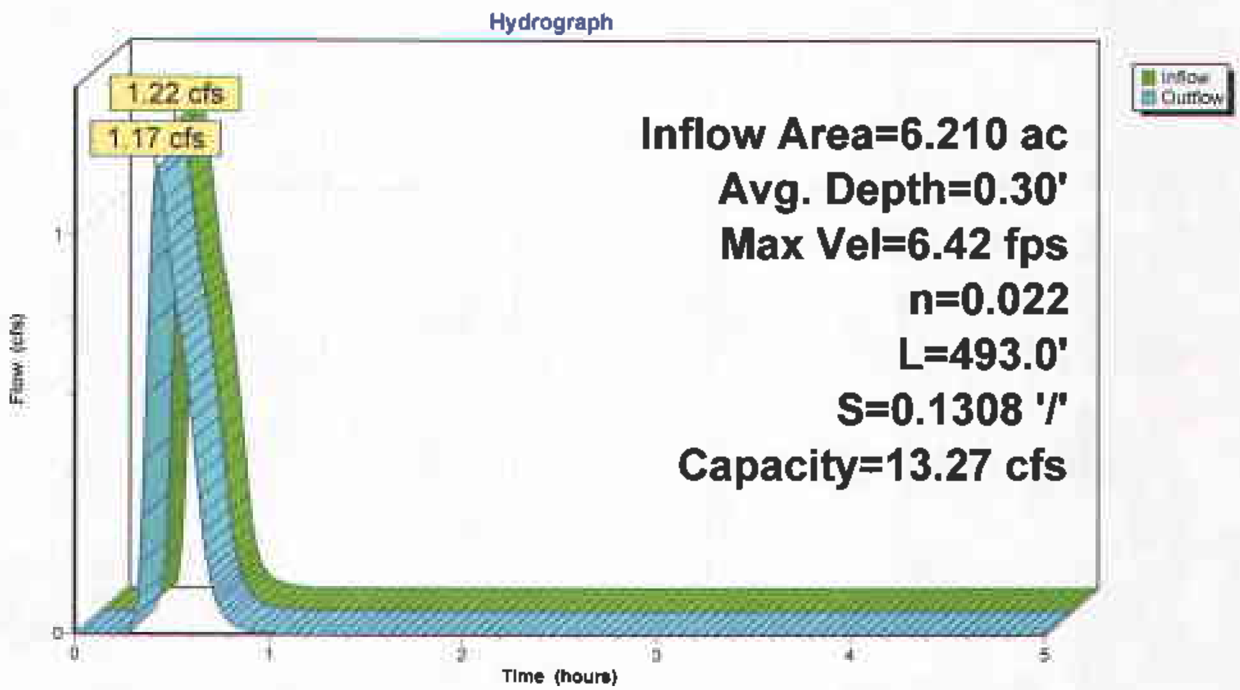
Inflow Area = 6.210 ac, 0.00% Impervious, Inflow Depth = 0.04"
Inflow = 1.22 cfs @ 0.37 hrs, Volume= 0.022 af
Outflow = 1.17 cfs @ 0.42 hrs, Volume= 0.022 af, Atten= 4%, Lag= 2.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.42 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 2.29 fps, Avg. Travel Time= 3.6 min

Peak Storage= 90 cf @ 0.40 hrs, Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 13.27 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 493.0' Slope= 0.1308 '/'
Inlet Invert= 6,124.50', Outlet Invert= 6,060.00'

Reach R2: Channel #5



Summary for Reach R3: Channel #5

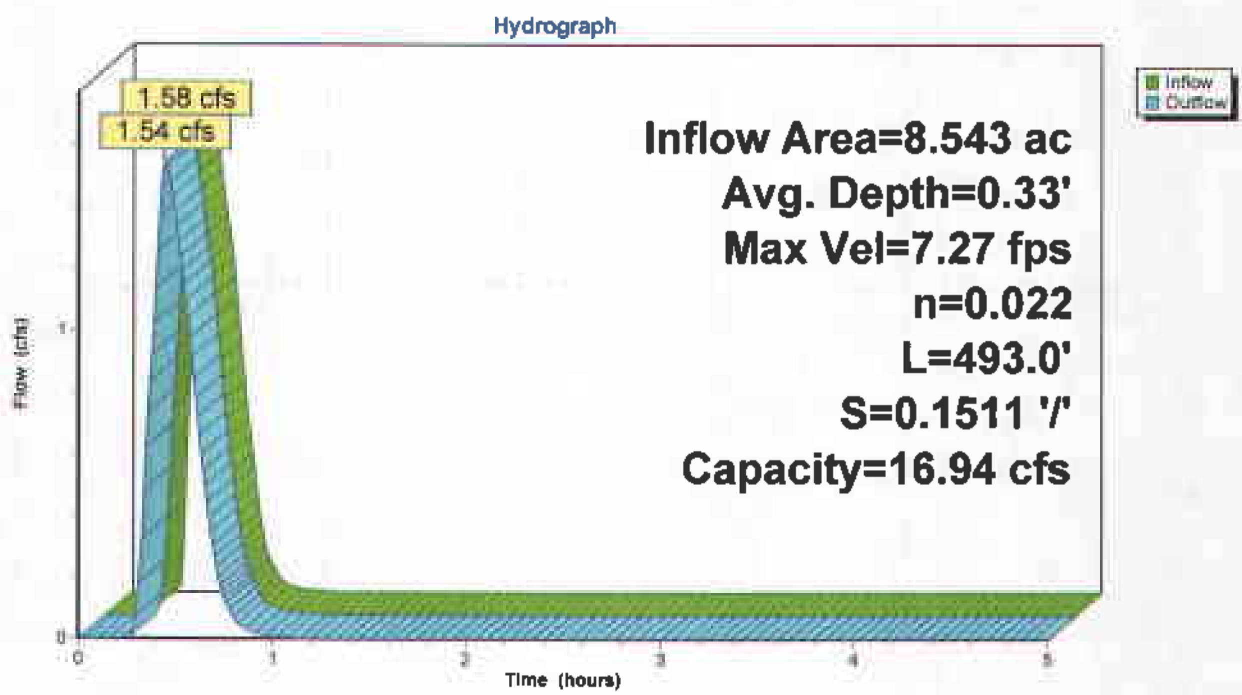
Inflow Area = 8.543 ac, 0.00% Impervious, Inflow Depth = 0.05"
Inflow = 1.58 cfs @ 0.41 hrs, Volume= 0.032 af
Outflow = 1.54 cfs @ 0.44 hrs, Volume= 0.032 af, Atten= 2%, Lag= 2.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.27 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 2.53 fps, Avg. Travel Time= 3.2 min

Peak Storage= 105 cf @ 0.43 hrs, Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 0.80', Capacity at Bank-Full= 16.94 cfs

0.00' x 0.80' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.20'
Length= 493.0' Slope= 0.1511 '/'
Inlet Invert= 6,059.50', Outlet Invert= 5,985.00'

Reach R3: Channel #5



Summary for Reach R4: Channel #5

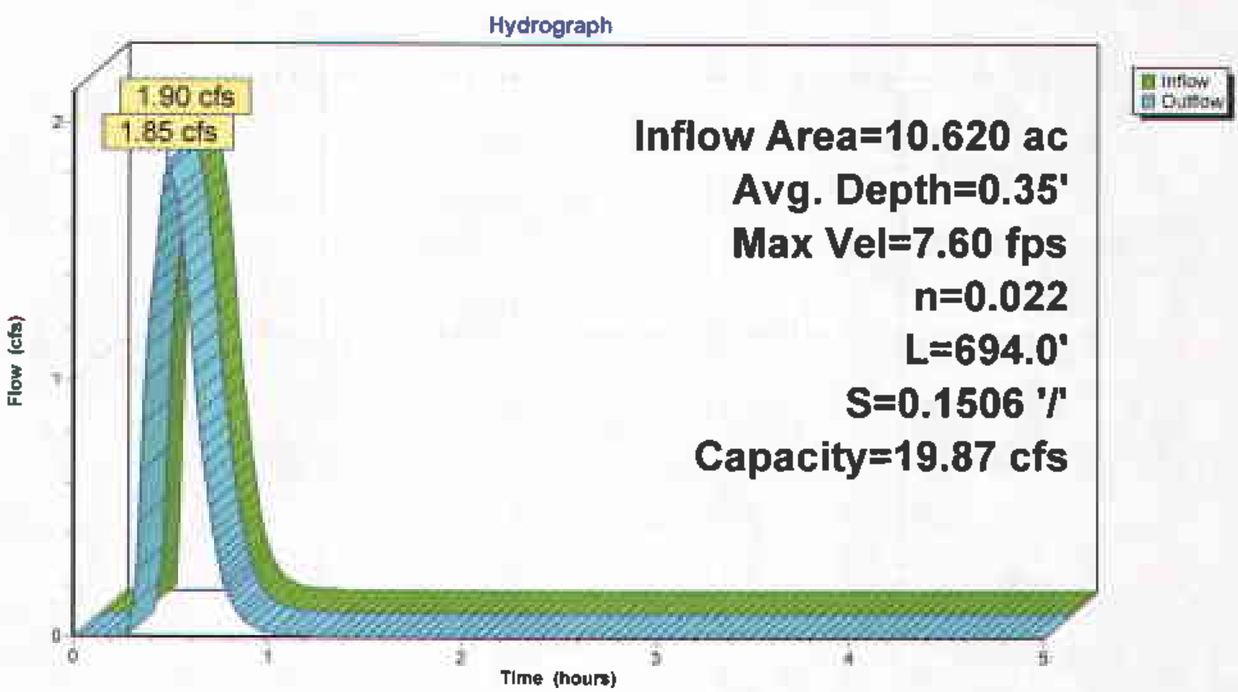
Inflow Area = 10.620 ac, 0.00% Impervious, Inflow Depth = 0.05"
Inflow = 1.90 cfs @ 0.44 hrs, Volume= 0.044 af
Outflow = 1.85 cfs @ 0.48 hrs, Volume= 0.044 af, Atten= 2%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.60 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 2.51 fps, Avg. Travel Time= 4.6 min

Peak Storage= 169 cf @ 0.46 hrs, Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 0.85', Capacity at Bank-Full= 19.87 cfs

0.00' x 0.85' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.40'
Length= 694.0' Slope= 0.1506 '/'
Inlet Invert= 5,984.50', Outlet Invert= 5,880.00'

Reach R4: Channel #5



Summary for Reach R5: Channel #5

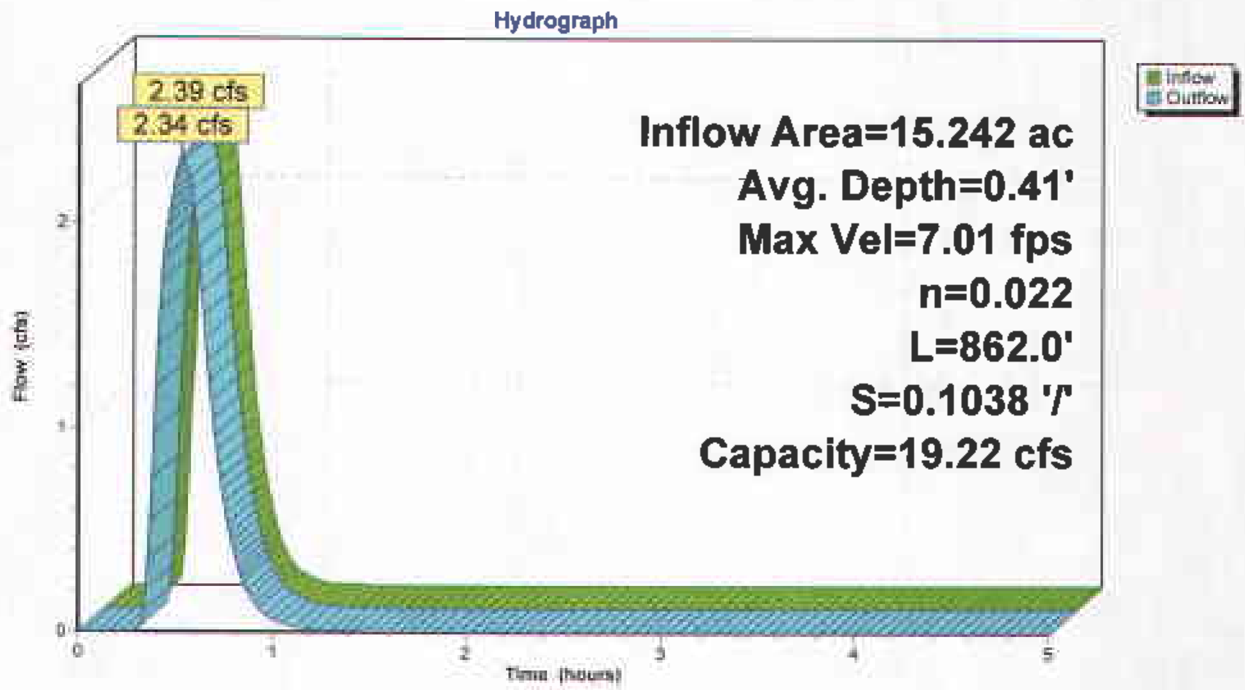
Inflow Area =	15.242 ac,	0.00% Impervious,	Inflow Depth =	0.05"
Inflow =	2.39 cfs @	0.47 hrs,	Volume=	0.060 af
Outflow =	2.34 cfs @	0.53 hrs,	Volume=	0.060 af, Atten= 2%, Lag= 3.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.01 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 2.09 fps, Avg. Travel Time= 6.9 min

Peak Storage= 288 cf @ 0.50 hrs, Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 0.90', Capacity at Bank-Full= 19.22 cfs

0.00' x 0.90' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.60'
Length= 862.0' Slope= 0.1038 '/'
Inlet Invert= 5,879.50', Outlet Invert= 5,790.00'

Reach R5: Channel #5



Summary for Reach R6: Channel #5

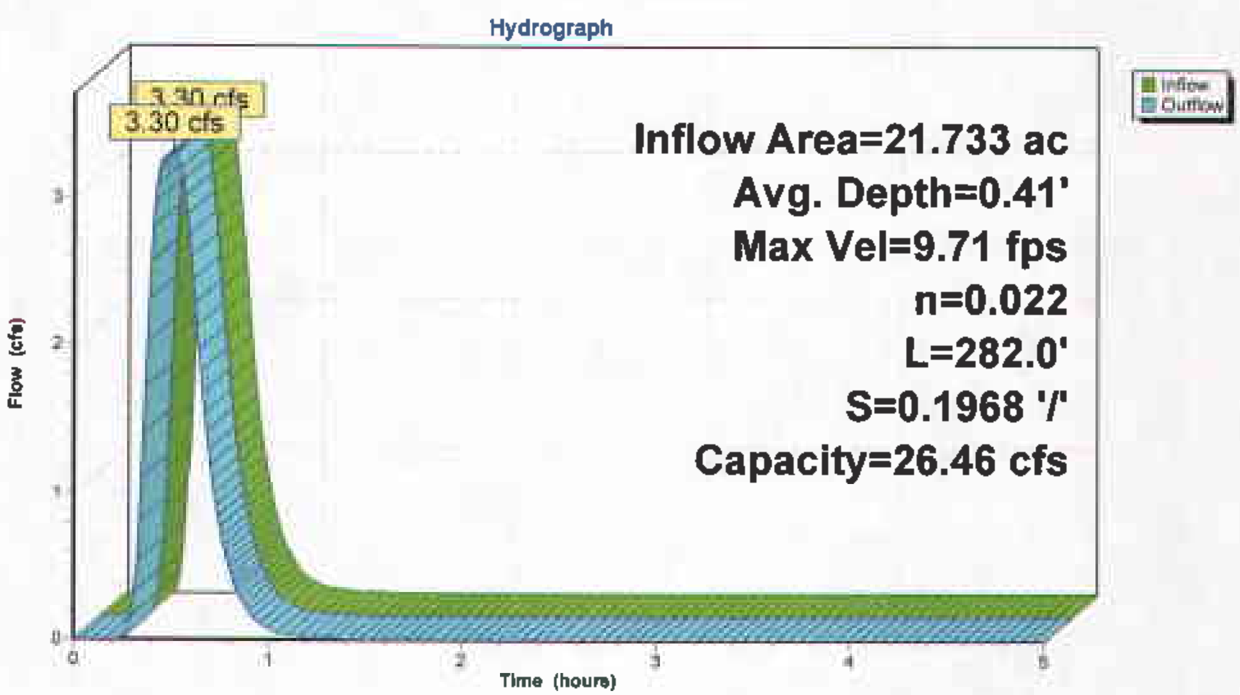
Inflow Area = 21.733 ac, 0.00% Impervious, Inflow Depth = 0.05"
Inflow = 3.30 cfs @ 0.50 hrs, Volume= 0.090 af
Outflow = 3.30 cfs @ 0.52 hrs, Volume= 0.090 af, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.71 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 3.01 fps, Avg. Travel Time= 1.6 min

Peak Storage= 96 cf @ 0.51 hrs, Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 0.90', Capacity at Bank-Full= 26.46 cfs

0.00' x 0.90' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.60'
Length= 282.0' Slope= 0.1968 '/'
Inlet Invert= 5,789.50', Outlet Invert= 5,734.00'

Reach R6: Channel #5



Summary for Pond WP3: WP #3

Inflow Area =	21.919 ac,	0.00% Impervious,	Inflow Depth =	0.05"
Inflow =	3.31 cfs @	0.51 hrs, Volume=	0.090 af	
Outflow =	0.00 cfs @	0.00 hrs, Volume=	0.000 af, Atten= 100%, Lag= 0.0 min	
Primary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Peak Elev= 5,726.61' @ 5.00 hrs Surf.Area= 1,284 sf Storage= 3,936 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

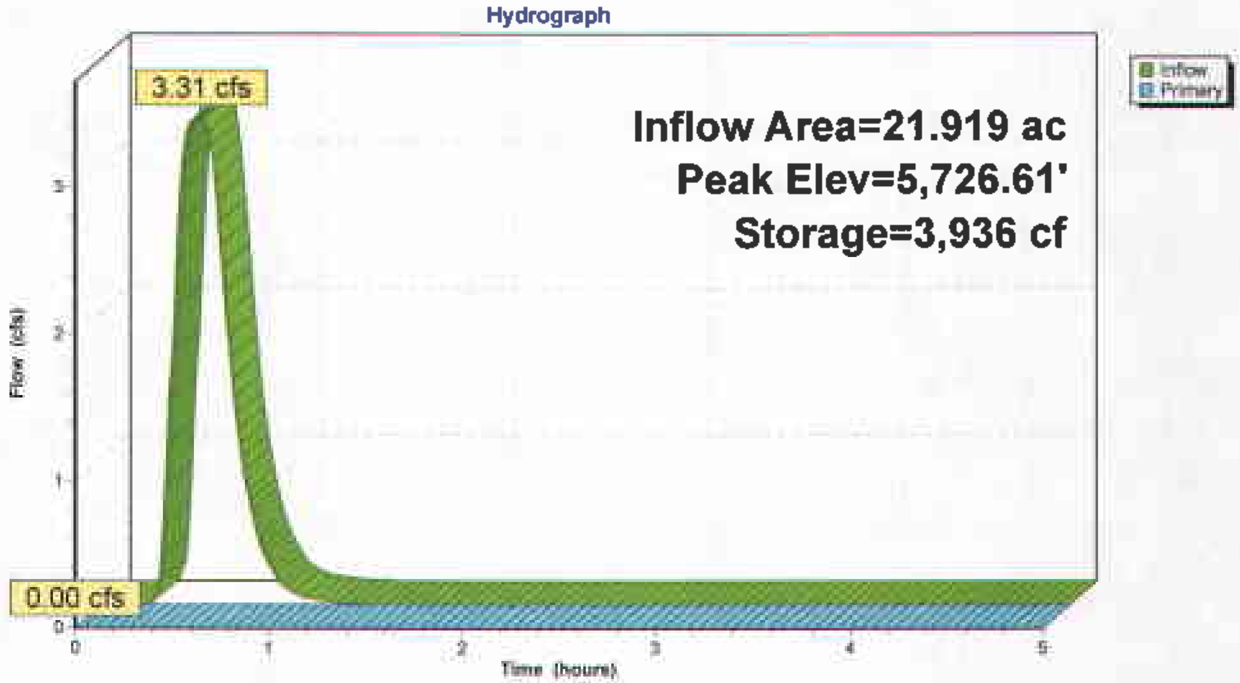
Volume	Invert	Avail.Storage	Storage Description
#1	5,721.00'	21,948 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

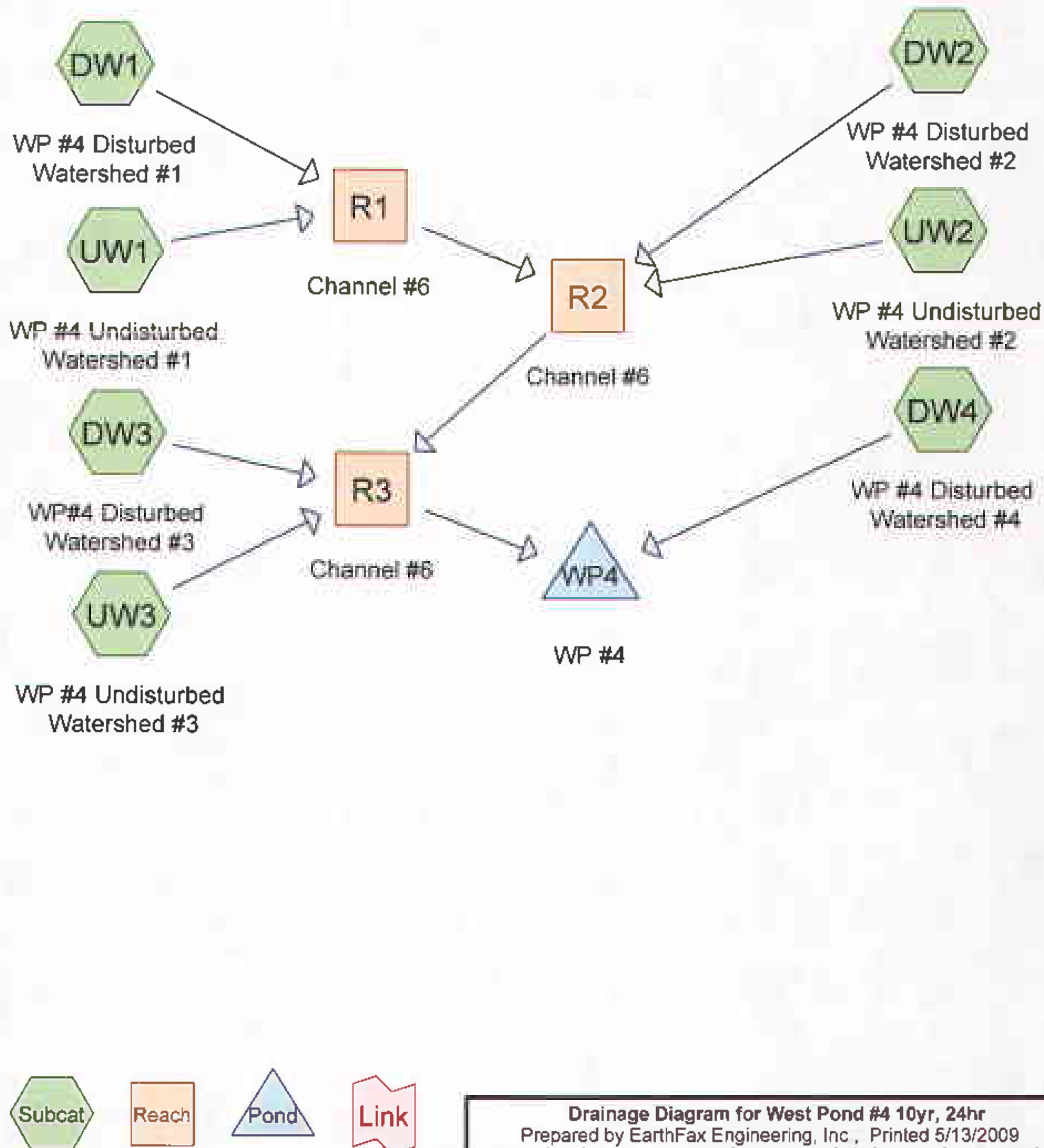
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,721.00	246	0	0
5,722.00	374	310	310
5,723.00	527	451	761
5,724.00	704	616	1,376
5,725.00	905	805	2,181
5,726.00	1,131	1,018	3,199
5,727.00	1,381	1,256	4,455
5,728.00	1,655	1,518	5,973
5,729.00	1,953	1,804	7,777
5,730.00	2,277	2,115	9,892
5,731.00	2,624	2,451	12,342
5,732.00	2,996	2,810	15,152
5,733.00	3,392	3,194	18,346
5,734.00	3,812	3,602	21,948

Device	Routing	Invert	Outlet Devices
#1	Primary	5,732.00'	**Special & User-Defined** Head (feet) 0.00 0.27 Disch. (cfs) 0.000 1.360

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5,721.00' (Free Discharge)
└─**1=Special & User-Defined** (Controls 0.00 cfs)

Pond WP3: WP #3


Hydrograph
3.31 cfs
0.00 cfs
Inflow Area=21.919 ac
Peak Elev=5,726.61'
Storage=3,936 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5



Drainage Diagram for West Pond #4 10yr, 24hr
Prepared by EarthFax Engineering, Inc , Printed 5/13/2009

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW1: WP #4 Disturbed Runoff Area=0.424 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=493' Slope=0.0410 '/' Tc=8.4 min CN=82 Runoff=0.32 cfs 0.017 af

Subcatchment DW2: WP #4 Disturbed Runoff Area=0.391 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=443' Slope=0.1350 '/' Tc=4.2 min CN=82 Runoff=0.35 cfs 0.016 af

Subcatchment DW3: WP#4 Disturbed Runoff Area=0.388 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=443' Slope=0.0870 '/' Tc=5.3 min CN=82 Runoff=0.33 cfs 0.016 af

Subcatchment DW4: WP #4 Disturbed Runoff Area=3.134 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=394' Slope=0.1320 '/' Tc=3.9 min CN=82 Runoff=2.84 cfs 0.128 af

Subcatchment UW1: WP #4 Undisturbed Runoff Area=2.137 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=407' Slope=0.3690 '/' Tc=3.7 min CN=67 Runoff=0.13 cfs 0.018 af

Subcatchment UW2: WP #4 Undisturbed Runoff Area=1.320 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=234' Slope=0.3210 '/' Tc=2.5 min CN=67 Runoff=0.09 cfs 0.011 af

Subcatchment UW3: WP #4 Undisturbed Runoff Area=1.394 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=182' Slope=0.6590 '/' Tc=1.4 min CN=67 Runoff=0.10 cfs 0.012 af

Reach R1: Channel #6 Avg. Depth=0.20' Max Vel=5.22 fps Inflow=0.46 cfs 0.036 af
n=0.022 L=400.0' S=0.1500 '/' Capacity=11.82 cfs Outflow=0.41 cfs 0.036 af

Reach R2: Channel #6 Avg. Depth=0.35' Max Vel=2.70 fps Inflow=0.71 cfs 0.063 af
n=0.022 L=490.0' S=0.0194 '/' Capacity=7.13 cfs Outflow=0.64 cfs 0.063 af

Reach R3: Channel #6 Avg. Depth=0.22' Max Vel=8.79 fps Inflow=0.82 cfs 0.091 af
n=0.022 L=185.0' S=0.3838 '/' Capacity=22.73 cfs Outflow=0.81 cfs 0.091 af

Pond WP4: WP #4 Peak Elev=5,595.36' Storage=9,528 cf Inflow=3.44 cfs 0.219 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 9.188 ac Runoff Volume = 0.219 af Average Runoff Depth = 0.29"
100.00% Pervious = 9.188 ac 0.00% Impervious = 0.000 ac

Summary for Reach R1: Channel #6

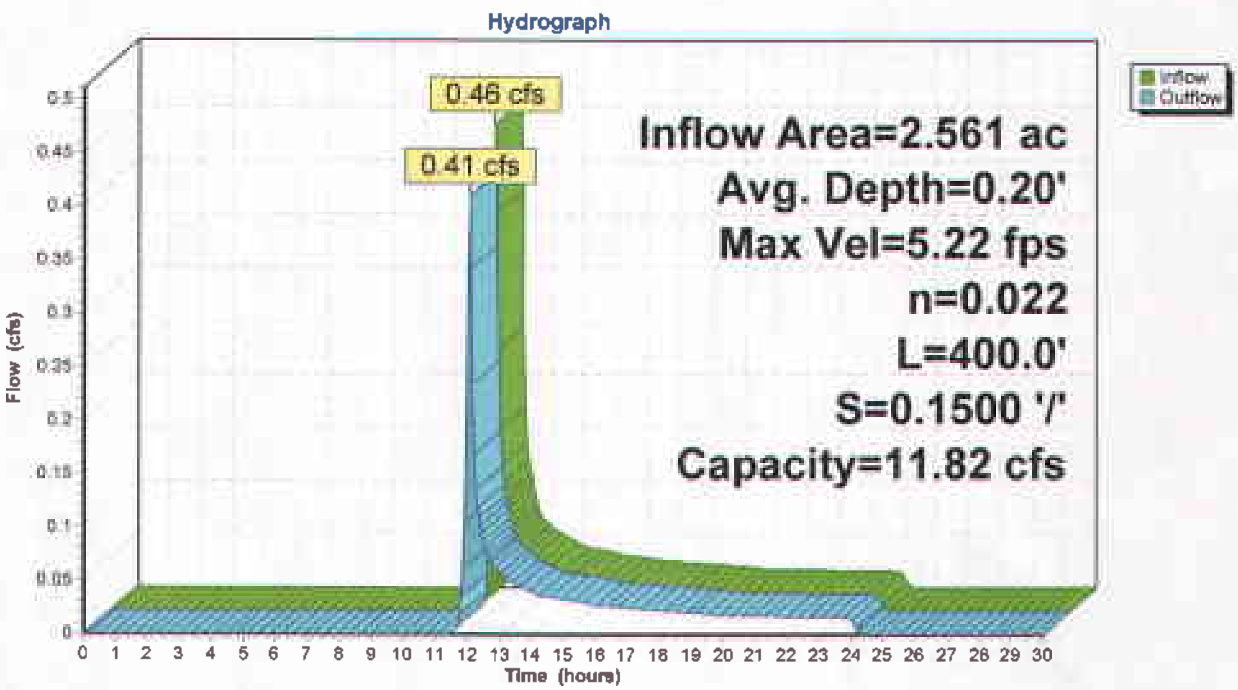
Inflow Area = 2.561 ac, 0.00% Impervious, Inflow Depth = 0.17"
Inflow = 0.46 cfs @ 12.01 hrs, Volume= 0.036 af
Outflow = 0.41 cfs @ 12.05 hrs, Volume= 0.036 af, Atten= 10%, Lag= 2.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.22 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 2.56 fps, Avg. Travel Time= 2.6 min

Peak Storage= 33 cf @ 12.03 hrs, Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 0.70', Capacity at Bank-Full= 11.82 cfs

0.00' x 0.70' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 2.80'
Length= 400.0' Slope= 0.1500 '/'
Inlet Invert= 5,770.00', Outlet Invert= 5,710.00'

Reach R1: Channel #6



Summary for Reach R2: Channel #6

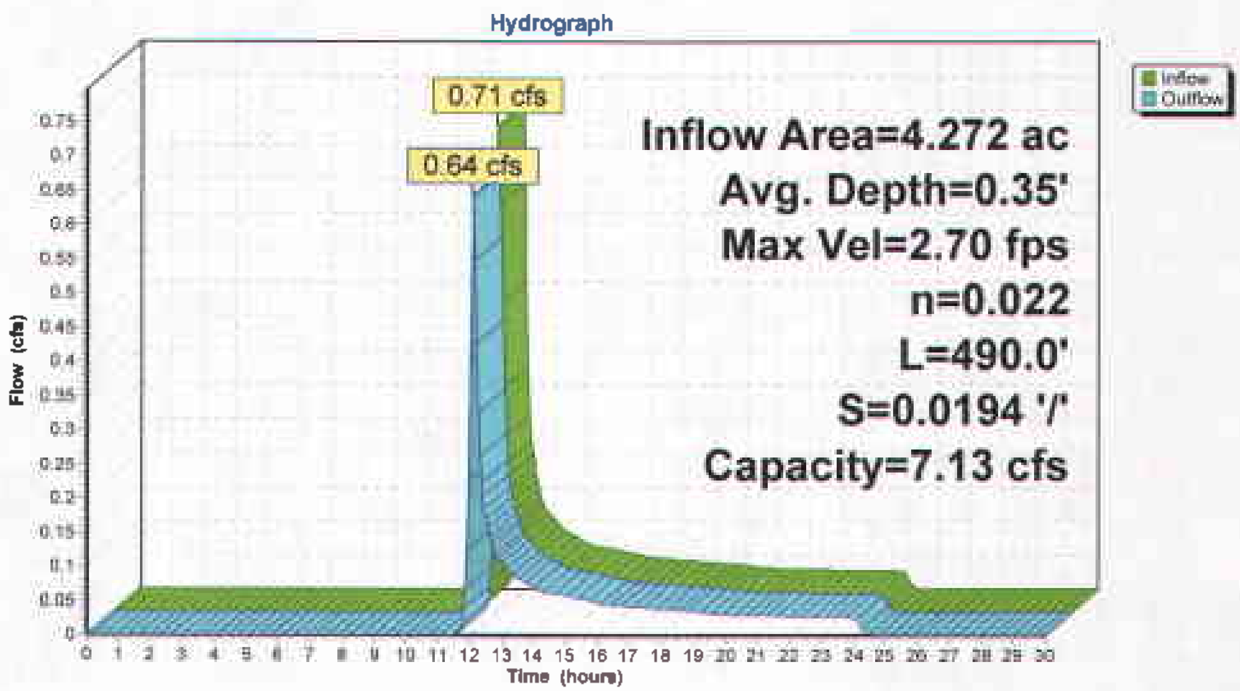
Inflow Area = 4.272 ac, 0.00% Impervious, Inflow Depth = 0.18"
Inflow = 0.71 cfs @ 12.00 hrs, Volume= 0.063 af
Outflow = 0.64 cfs @ 12.09 hrs, Volume= 0.063 af, Atten= 10%, Lag= 5.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.70 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 1.28 fps, Avg. Travel Time= 6.4 min

Peak Storage= 117 cf @ 12.04 hrs, Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 0.85', Capacity at Bank-Full= 7.13 cfs

0.00' x 0.85' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.40'
Length= 490.0' Slope= 0.0194 '/'
Inlet Invert= 5,709.50', Outlet Invert= 5,700.00'

Reach R2: Channel #6



Summary for Reach R3: Channel #6

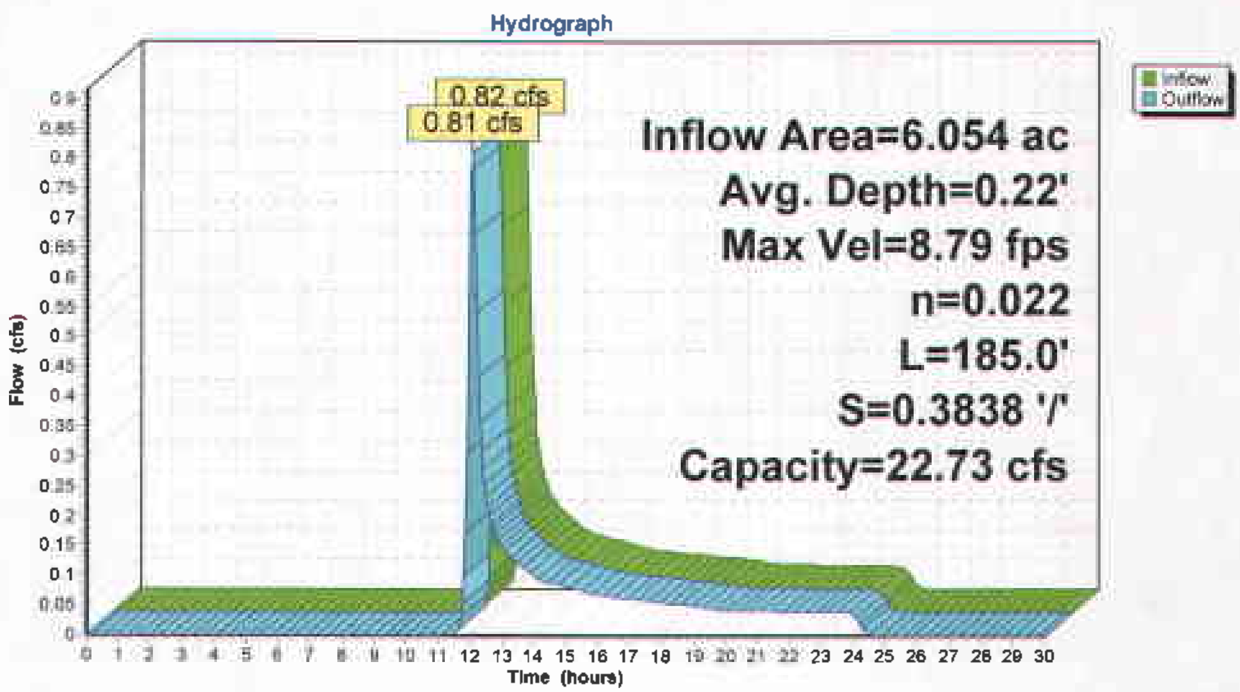
Inflow Area = 6.054 ac, 0.00% Impervious, Inflow Depth = 0.18"
Inflow = 0.82 cfs @ 12.04 hrs, Volume= 0.091 af
Outflow = 0.81 cfs @ 12.06 hrs, Volume= 0.091 af, Atten= 1%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.79 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 4.43 fps, Avg. Travel Time= 0.7 min

Peak Storage= 17 cf @ 12.04 hrs, Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 22.73 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 185.0' Slope= 0.3838 '/'
Inlet Invert= 5,669.50', Outlet Invert= 5,598.50'

Reach R3: Channel #6



Summary for Pond WP4: WP #4

Inflow Area =	9.188 ac,	0.00% Impervious,	Inflow Depth =	0.29"
Inflow =	3.44 cfs @	11.96 hrs, Volume=	0.219 af	
Outflow =	0.00 cfs @	0.00 hrs, Volume=	0.000 af, Atten= 100%, Lag= 0.0 min	
Primary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 5,595.36' @ 30.00 hrs Surf.Area= 3,083 sf Storage= 9,528 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

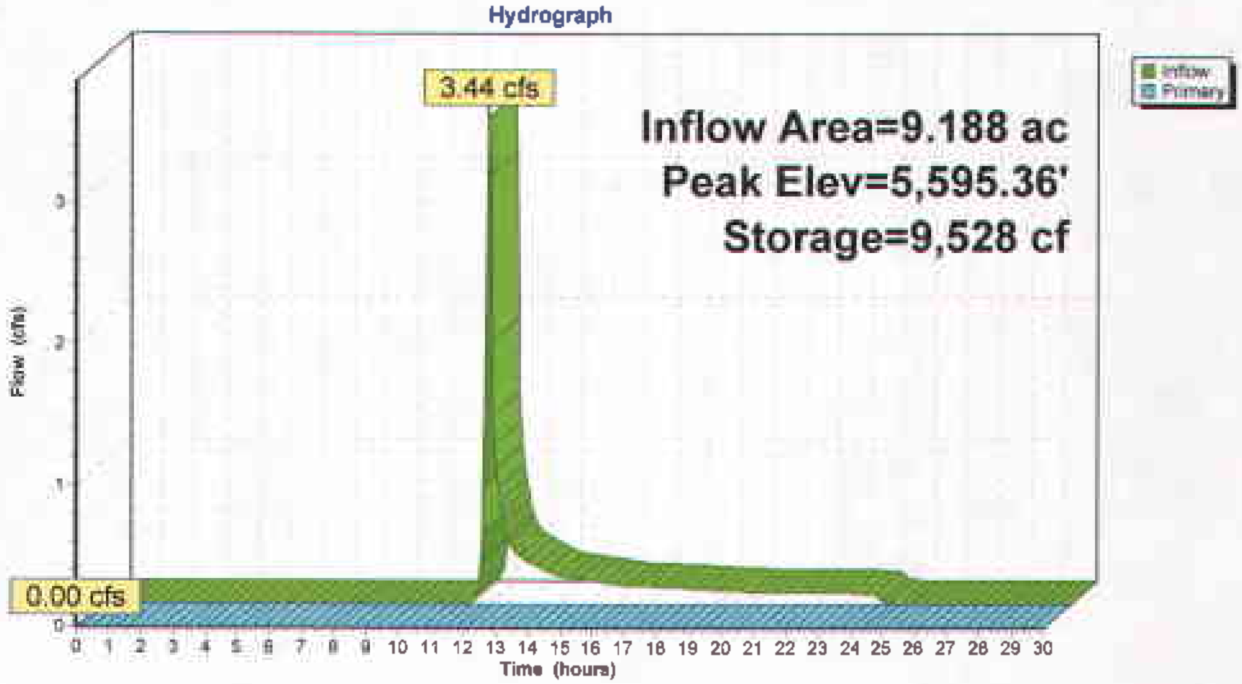
Volume	Invert	Avail.Storage	Storage Description
#1	5,591.00'	19,337 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

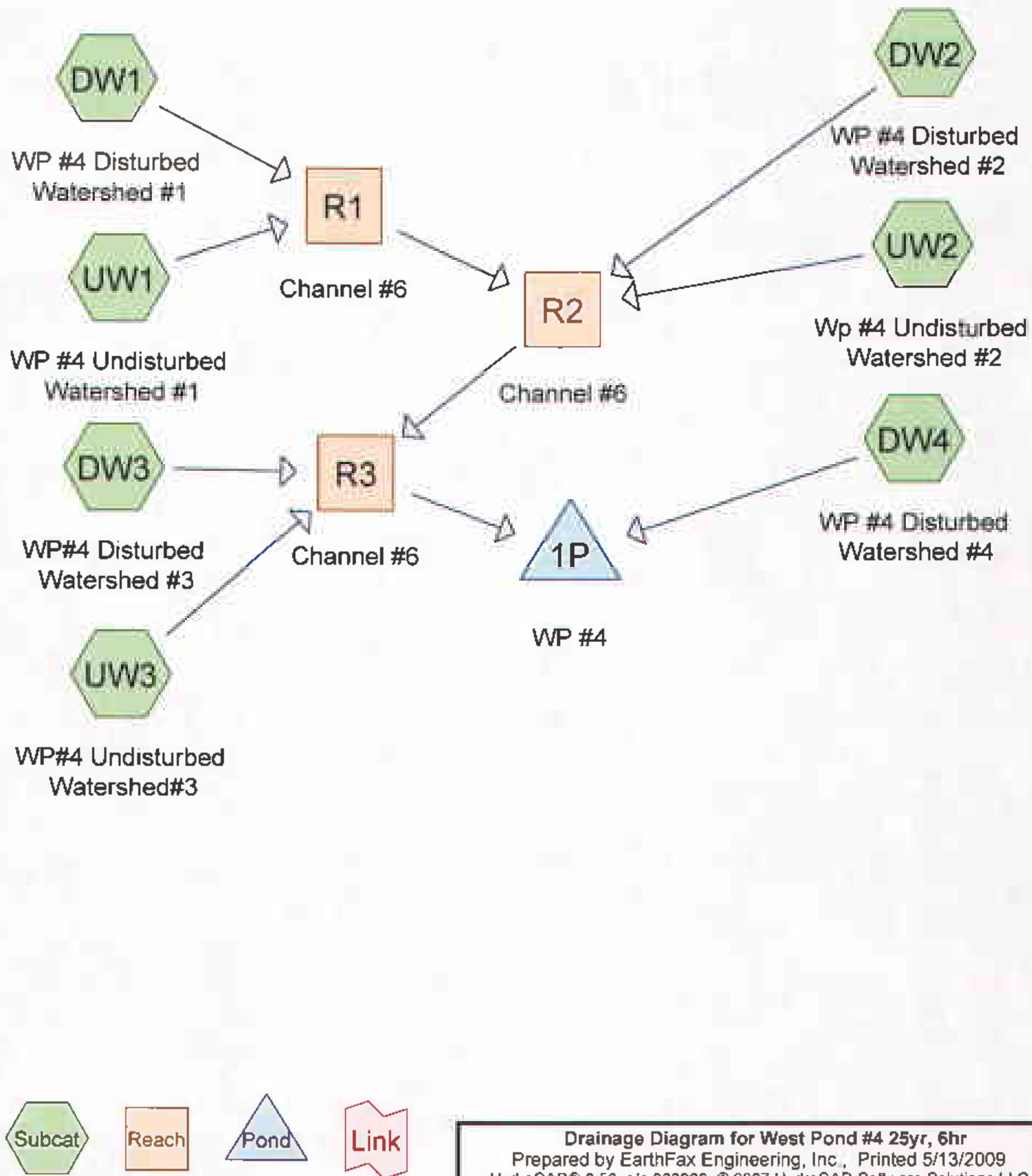
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,591.00	1,380	0	0
5,592.00	1,717	1,549	1,549
5,593.00	2,086	1,902	3,450
5,594.00	2,485	2,286	5,736
5,595.00	2,915	2,700	8,436
5,596.00	3,377	3,146	11,582
5,597.00	3,870	3,624	15,205
5,598.00	4,394	4,132	19,337

Device	Routing	Invert	Outlet Devices
#1	Primary	5,596.00'	**Special & User-Defined** Head (feet) 0.00 0.21 Disch. (cfs) 0.000 2.990

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5,591.00' (Free Discharge)
└─**1=Special & User-Defined** (Controls 0.00 cfs)

Pond WP4: WP #4


Hydrograph
3.44 cfs
0.00 cfs
Inflow Area=9.188 ac
Peak Elev=5,595.36'
Storage=9,528 cf
Inflow
Primary
Flow (cfs)
0
1
2
3
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Time (hours)



Drainage Diagram for West Pond #4 25yr, 6hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-12.00 hrs, dt=0.05 hrs, 241 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW1: WP #4 Disturbed Runoff Area=0.424 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=493' Slope=0.0410 '/' Tc=8.4 min CN=82 Runoff=0.31 cfs 0.011 af

Subcatchment DW2: WP #4 Disturbed Runoff Area=0.391 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=443' Slope=0.1350 '/' Tc=4.2 min CN=82 Runoff=0.39 cfs 0.010 af

Subcatchment DW3: WP#4 Disturbed Runoff Area=0.388 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=443' Slope=0.0870 '/' Tc=5.3 min CN=82 Runoff=0.38 cfs 0.010 af

Subcatchment DW4: WP #4 Disturbed Runoff Area=3.134 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=394' Slope=0.1320 '/' Tc=3.9 min CN=82 Runoff=3.08 cfs 0.078 af

Subcatchment UW1: WP #4 Undisturbed Runoff Area=2.137 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=407' Slope=0.3690 '/' Tc=3.7 min CN=67 Runoff=0.03 cfs 0.006 af

Subcatchment UW2: Wp #4 Undisturbed Runoff Area=1.320 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=234' Slope=0.3210 '/' Tc=2.5 min CN=67 Runoff=0.02 cfs 0.004 af

Subcatchment UW3: WP#4 Undisturbed Runoff Area=1.394 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=182' Slope=0.6590 '/' Tc=1.4 min CN=67 Runoff=0.02 cfs 0.004 af

Reach R1: Channel #6 Avg. Depth=0.18' Max Vel=4.81 fps Inflow=0.31 cfs 0.017 af
n=0.022 L=400.0' S=0.1500 '/' Capacity=11.82 cfs Outflow=0.28 cfs 0.017 af

Reach R2: Channel #6 Avg. Depth=0.29' Max Vel=2.42 fps Inflow=0.49 cfs 0.030 af
n=0.022 L=490.0' S=0.0194 '/' Capacity=7.13 cfs Outflow=0.41 cfs 0.030 af

Reach R3: Channel #6 Avg. Depth=0.21' Max Vel=5.89 fps Inflow=0.53 cfs 0.043 af
n=0.022 L=406.0' S=0.1761 '/' Capacity=15.39 cfs Outflow=0.52 cfs 0.043 af

Pond 1P: WP #4 Peak Elev=5,596.18' Storage=616 cf Inflow=3.29 cfs 0.121 af
Outflow=2.10 cfs 0.121 af

Total Runoff Area = 9.188 ac Runoff Volume = 0.121 af Average Runoff Depth = 0.16"
100.00% Pervious = 9.188 ac 0.00% Impervious = 0.000 ac

Summary for Reach R1: Channel #6

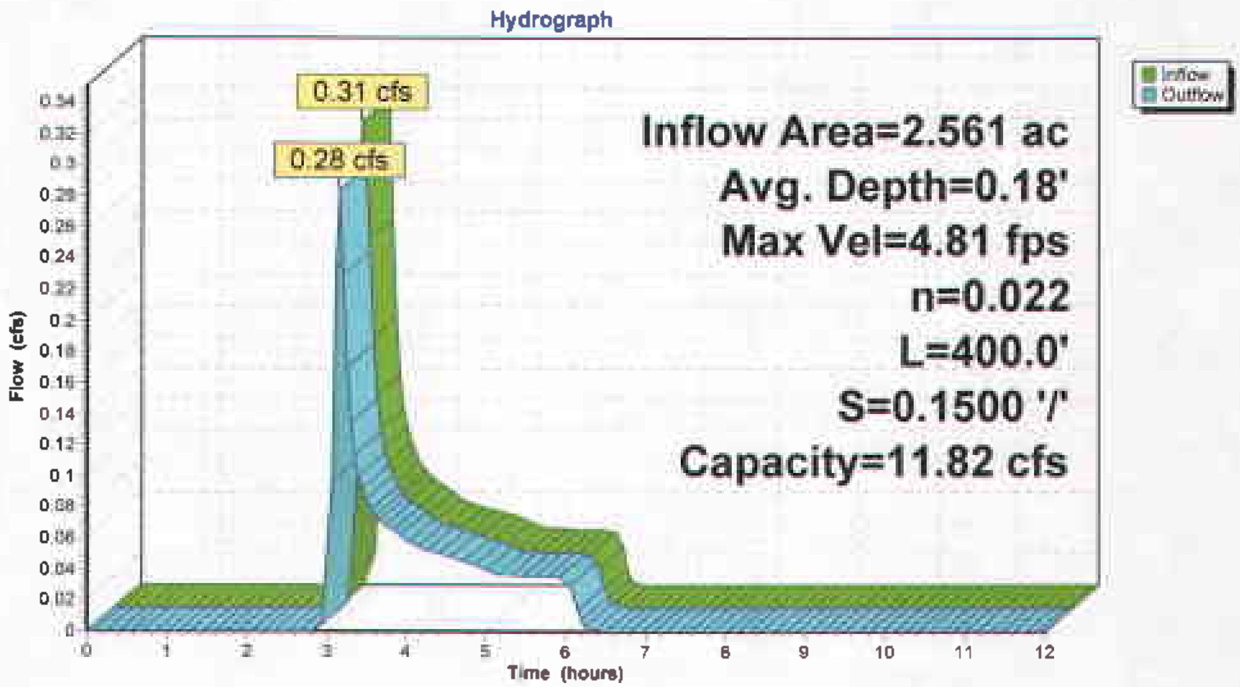
Inflow Area = 2.561 ac, 0.00% Impervious, Inflow Depth = 0.08"
Inflow = 0.31 cfs @ 3.10 hrs, Volume= 0.017 af
Outflow = 0.28 cfs @ 3.15 hrs, Volume= 0.017 af, Atten= 9%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.81 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 2.85 fps, Avg. Travel Time= 2.3 min

Peak Storage= 26 cf @ 3.12 hrs, Average Depth at Peak Storage= 0.18'
Bank-Full Depth= 0.70', Capacity at Bank-Full= 11.82 cfs

0.00' x 0.70' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 2.80'
Length= 400.0' Slope= 0.1500 '/'
Inlet Invert= 5,770.00', Outlet Invert= 5,710.00'

Reach R1: Channel #6



Summary for Reach R2: Channel #6

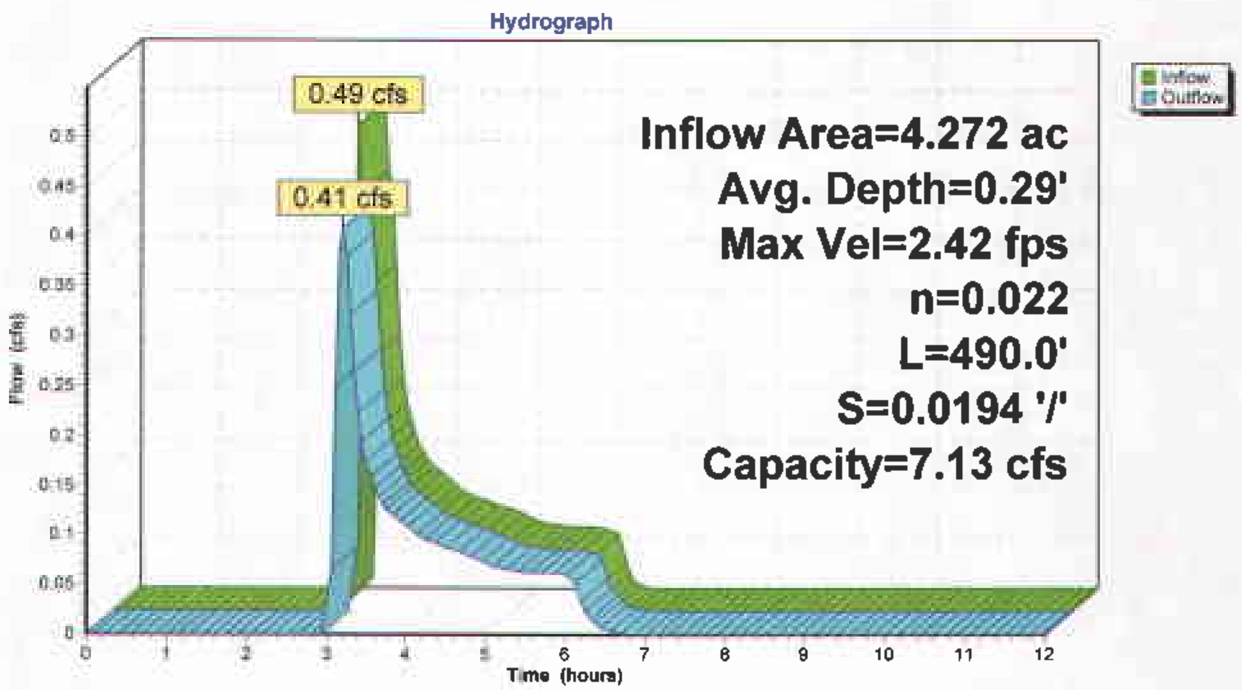
Inflow Area =	4.272 ac,	0.00% Impervious,	Inflow Depth = 0.08"		
Inflow =	0.49 cfs @	3.06 hrs,	Volume=	0.030 af	
Outflow =	0.41 cfs @	3.20 hrs,	Volume=	0.030 af,	Atten= 16%, Lag= 8.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.42 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 1.26 fps, Avg. Travel Time= 6.5 min

Peak Storage= 83 cf @ 3.14 hrs, Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 0.85', Capacity at Bank-Full= 7.13 cfs

0.00' x 0.85' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.40'
Length= 490.0' Slope= 0.0194 '/'
Inlet Invert= 5,709.50', Outlet Invert= 5,700.00'

Reach R2: Channel #6



Summary for Reach R3: Channel #6

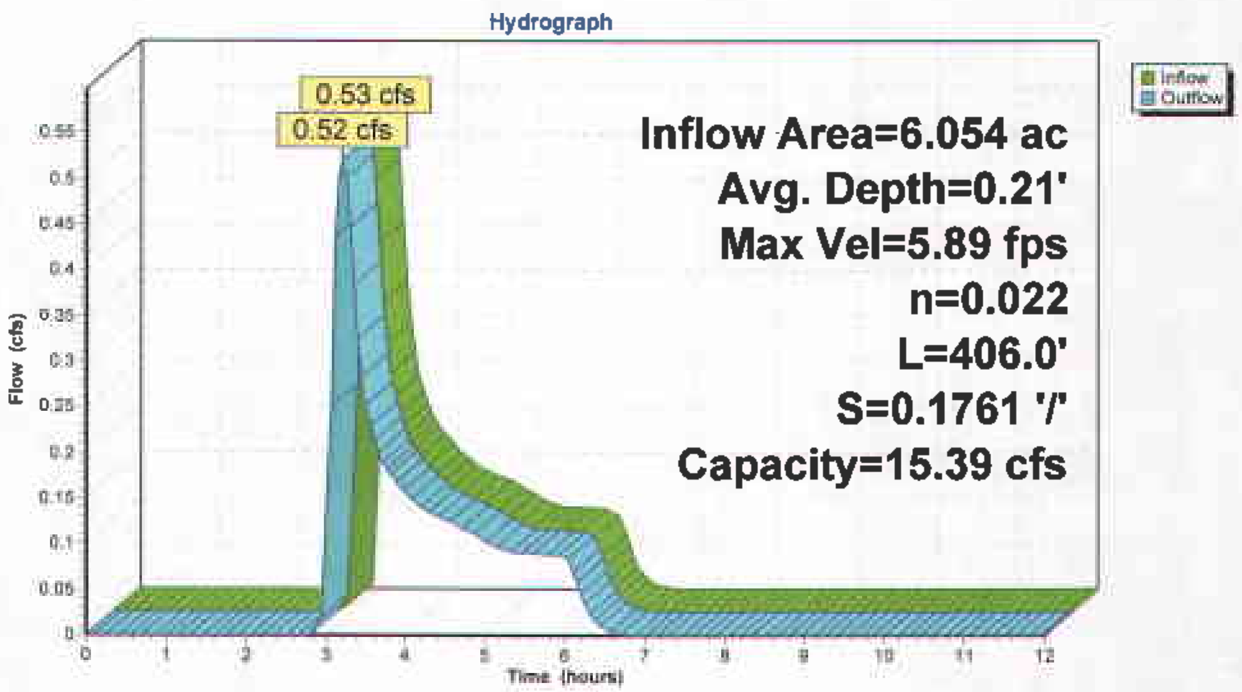
Inflow Area = 6.054 ac, 0.00% Impervious, Inflow Depth = 0.09"
Inflow = 0.53 cfs @ 3.16 hrs, Volume= 0.043 af
Outflow = 0.52 cfs @ 3.20 hrs, Volume= 0.043 af, Atten= 2%, Lag= 2.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.89 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 3.33 fps, Avg. Travel Time= 2.0 min

Peak Storage= 36 cf @ 3.19 hrs, Average Depth at Peak Storage= 0.21'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 15.39 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 406.0' Slope= 0.1761 '/'
Inlet Invert= 5,669.50', Outlet Invert= 5,598.00'

Reach R3: Channel #6



Summary for Pond 1P: WP #4

Inflow Area = 9.188 ac, 0.00% Impervious, Inflow Depth = 0.16"
Inflow = 3.29 cfs @ 3.04 hrs, Volume= 0.121 af
Outflow = 2.10 cfs @ 3.10 hrs, Volume= 0.121 af, Atten= 36%, Lag= 3.9 min
Primary = 2.10 cfs @ 3.10 hrs, Volume= 0.121 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Peak Elev= 5,596.18' @ 3.10 hrs Surf.Area= 3,466 sf Storage= 616 cf

Plug-Flow detention time= 4.8 min calculated for 0.121 af (100% of inflow)
Center-of-Mass det. time= 4.9 min (237.2 - 232.4)

Volume	Invert	Avail.Storage	Storage Description
#1	5,591.00'	7,756 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

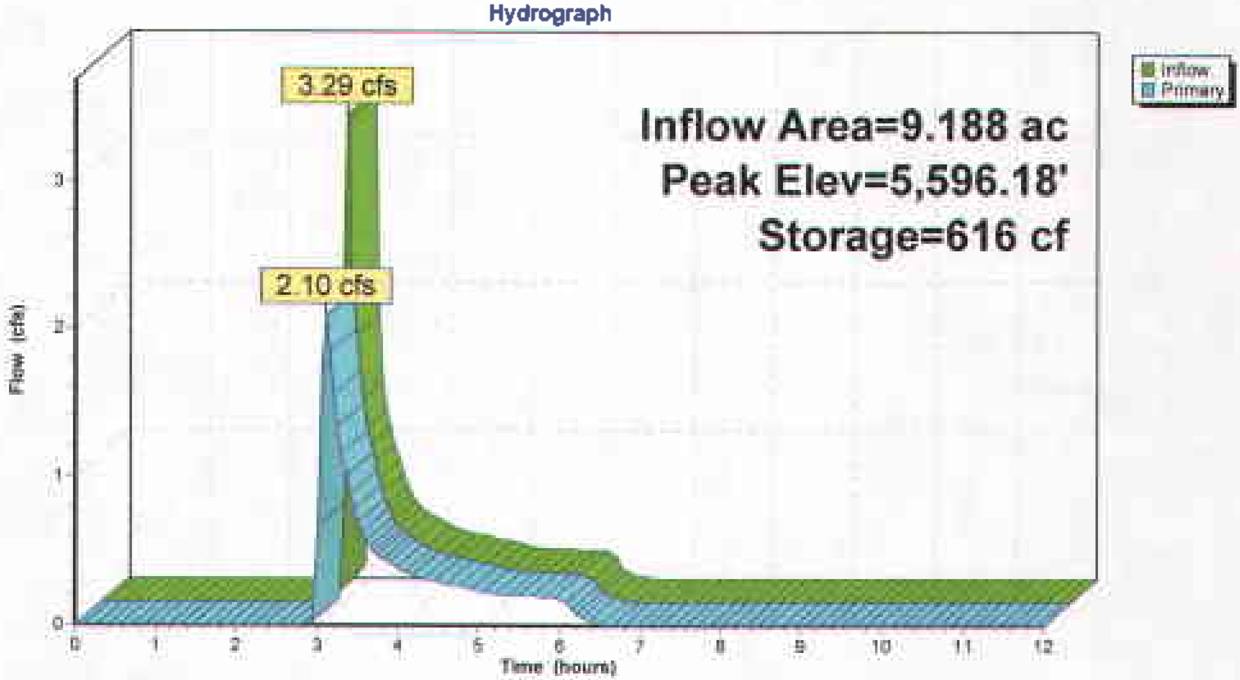
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,591.00	1,380	0.0	0	0
5,592.00	1,717	0.0	0	0
5,593.00	2,086	0.0	0	0
5,594.00	2,485	0.0	0	0
5,595.00	2,915	0.0	0	0
5,596.00	3,377	0.0	0	0
5,597.00	3,870	100.0	3,624	3,624
5,598.00	4,394	100.0	4,132	7,756

Device	Routing	Invert	Outlet Devices
#1	Primary	5,596.00'	**Special & User-Defined** Head (feet) 0.00 0.18 Disch. (cfs) 0.000 2.100

Primary OutFlow Max=2.07 cfs @ 3.10 hrs HW=5,596.18' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 2.07 cfs)

Pond 1P: WP #4

Hydrograph



West Pond #4 Spillway Top
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	West Pond #4 Spillwa
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0 040	
Slope	056000	ft/ft
Left Side Slope	0 50	V H
Right Side Slope	0 50	V H
Bottom Width	1 00	ft
Discharge	2 10	cfs

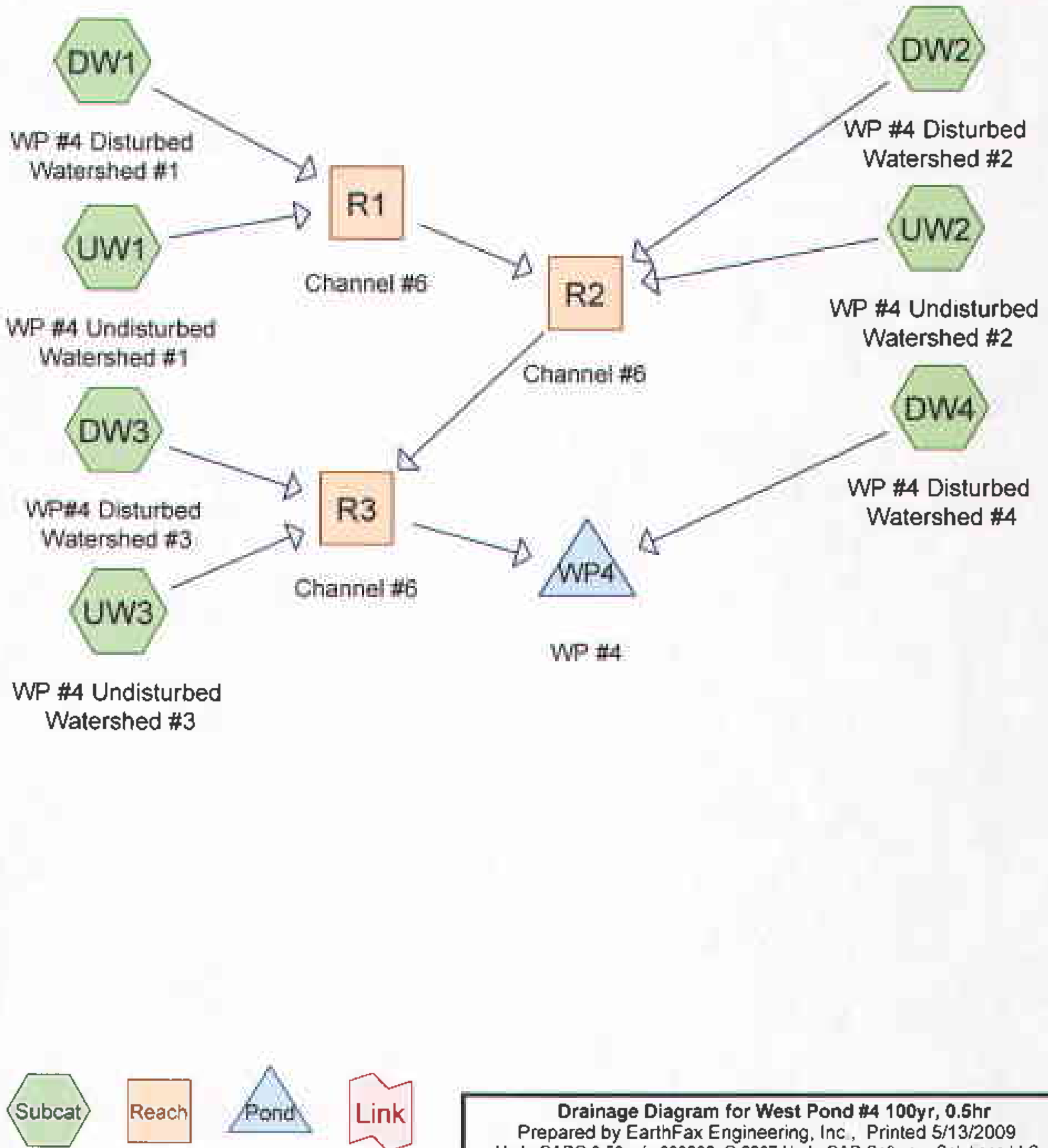
Results		
Depth	0 36	ft
Flow Area	0 6	ft²
Wetted Perim	2 62	ft
Top Width	2 44	ft
Critical Depth	0 40	ft
Critical Slope	0 039394	ft/ft
Velocity	3 38	ft/s
Velocity Head	0 18	ft
Specific Energ	0 54	ft
Froude Numb	1 18	
Flow Type	Supercritical	

West Pond #4 Spillway Bottom
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	West Pond #4 Spillway
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0 040	
Slope	333000	ft/ft
Left Side Slope	0 50	V : H
Right Side Slope	0 50	V : H
Bottom Width	1 00	ft
Discharge	2 10	cfs

Results		
Depth	0 23	ft
Flow Area	0 3	ft²
Wetted Perim	2 01	ft
Top Width	1 90	ft
Critical Depth	0 40	ft
Critical Slope	0 039394	ft/ft
Velocity	6 40	ft/s
Velocity Head	0 64	ft
Specific Energ	0 86	ft
Froude Numb	2 72	
Flow Type	Supercritical	



Drainage Diagram for West Pond #4 100yr, 0.5hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-5.00 hrs, dt=0.01 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW1: WP #4 Disturbed Runoff Area=0.424 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=493' Slope=0.0410 '/' Tc=8.4 min CN=82 Runoff=0.44 cfs 0.007 af

Subcatchment DW2: WP #4 Disturbed Runoff Area=0.391 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=443' Slope=0.1350 '/' Tc=4.2 min CN=82 Runoff=0.64 cfs 0.007 af

Subcatchment DW3: WP#4 Disturbed Runoff Area=0.388 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=443' Slope=0.0870 '/' Tc=5.3 min CN=82 Runoff=0.55 cfs 0.007 af

Subcatchment DW4: WP #4 Disturbed Runoff Area=3.134 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=394' Slope=0.1320 '/' Tc=3.9 min CN=82 Runoff=5.38 cfs 0.055 af

Subcatchment UW1: WP #4 Undisturbed Runoff Area=2.137 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=407' Slope=0.3690 '/' Tc=3.7 min CN=67 Runoff=0.13 cfs 0.002 af

Subcatchment UW2: WP #4 Undisturbed Runoff Area=1.320 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=234' Slope=0.3210 '/' Tc=2.5 min CN=67 Runoff=0.08 cfs 0.001 af

Subcatchment UW3: WP #4 Undisturbed Runoff Area=1.394 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=182' Slope=0.6590 '/' Tc=1.4 min CN=67 Runoff=0.09 cfs 0.001 af

Reach R1: Channel #6 Avg. Depth=0.22' Max Vel=5.54 fps Inflow=0.54 cfs 0.009 af
n=0.022 L=400.0' S=0.1500 '/' Capacity=11.82 cfs Outflow=0.53 cfs 0.009 af

Reach R2: Channel #6 Avg. Depth=0.37' Max Vel=2.83 fps Inflow=0.82 cfs 0.018 af
n=0.022 L=490.0' S=0.0194 '/' Capacity=7.13 cfs Outflow=0.77 cfs 0.018 af

Reach R3: Channel #6 Avg. Depth=0.23' Max Vel=9.26 fps Inflow=1.01 cfs 0.026 af
n=0.022 L=185.0' S=0.3838 '/' Capacity=22.73 cfs Outflow=1.00 cfs 0.026 af

Pond WP4: WP #4 Peak Elev=5,593.03' Storage=3,503 cf Inflow=5.71 cfs 0.080 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 9.188 ac Runoff Volume = 0.080 af Average Runoff Depth = 0.11"
100.00% Pervious = 9.188 ac 0.00% Impervious = 0.000 ac

Summary for Reach R1: Channel #6

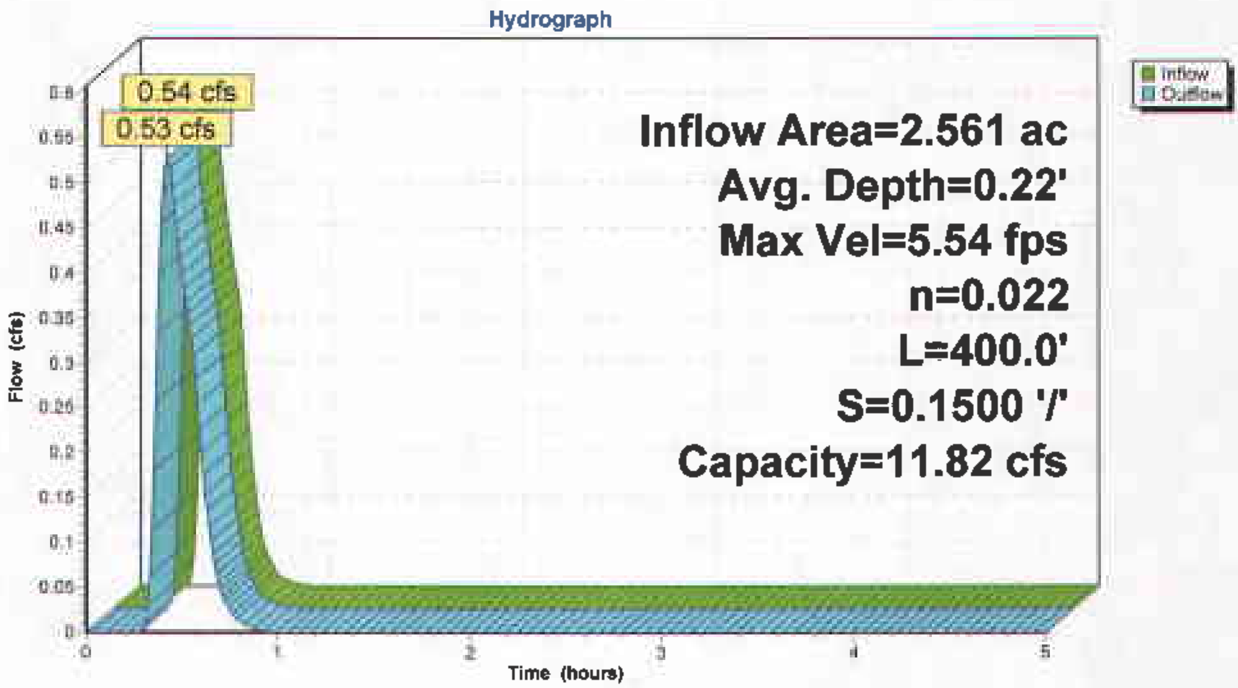
Inflow Area = 2.561 ac, 0.00% Impervious, Inflow Depth = 0.04"
Inflow = 0.54 cfs @ 0.39 hrs, Volume= 0.009 af
Outflow = 0.53 cfs @ 0.42 hrs, Volume= 0.009 af, Atten= 3%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.54 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 2.65 fps, Avg. Travel Time= 2.5 min

Peak Storage= 38 cf @ 0.40 hrs, Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 0.70', Capacity at Bank-Full= 11.82 cfs

0.00' x 0.70' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 2.80'
Length= 400.0' Slope= 0.1500 '/'
Inlet Invert= 5,770.00', Outlet Invert= 5,710.00'

Reach R1: Channel #6



Summary for Reach R2: Channel #6

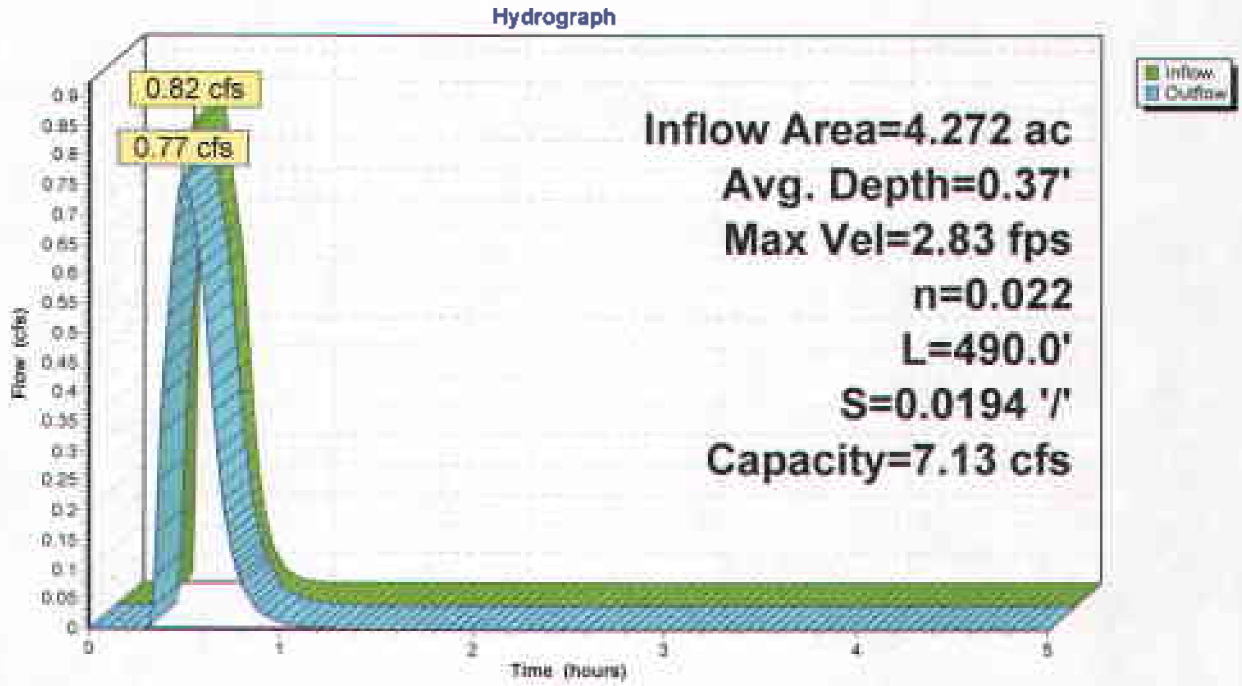
Inflow Area = 4.272 ac, 0.00% Impervious, Inflow Depth = 0.05"
Inflow = 0.82 cfs @ 0.41 hrs, Volume= 0.018 af
Outflow = 0.77 cfs @ 0.49 hrs, Volume= 0.018 af, Atten= 7%, Lag= 4.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.83 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 0.90 fps, Avg. Travel Time= 9.1 min

Peak Storage= 133 cf @ 0.44 hrs, Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 0.85', Capacity at Bank-Full= 7.13 cfs

0.00' x 0.85' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.40'
Length= 490.0' Slope= 0.0194 '/'
Inlet Invert= 5,709.50', Outlet Invert= 5,700.00'

Reach R2: Channel #6



Summary for Reach R3: Channel #6

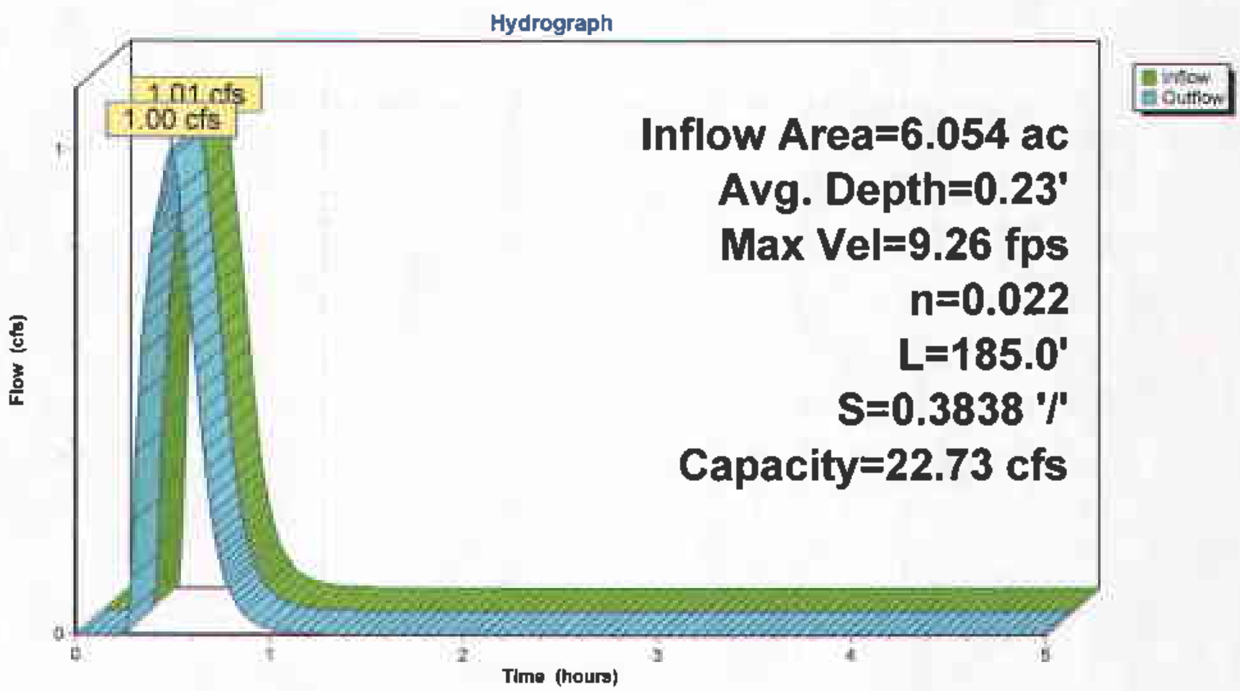
Inflow Area = 6.054 ac, 0.00% Impervious, Inflow Depth = 0.05"
Inflow = 1.01 cfs @ 0.48 hrs, Volume= 0.026 af
Outflow = 1.00 cfs @ 0.49 hrs, Volume= 0.026 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.26 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.65 fps, Avg. Travel Time= 0.8 min

Peak Storage= 20 cf @ 0.49 hrs, Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 22.73 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 185.0' Slope= 0.3838 '/'
Inlet Invert= 5,669.50', Outlet Invert= 5,598.50'

Reach R3: Channel #6



Summary for Pond WP4: WP #4

Inflow Area = 9.188 ac, 0.00% Impervious, Inflow Depth = 0.11"
Inflow = 5.71 cfs @ 0.31 hrs, Volume= 0.080 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Peak Elev= 5,593.03' @ 5.00 hrs Surf.Area= 2,096 sf Storage= 3,503 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

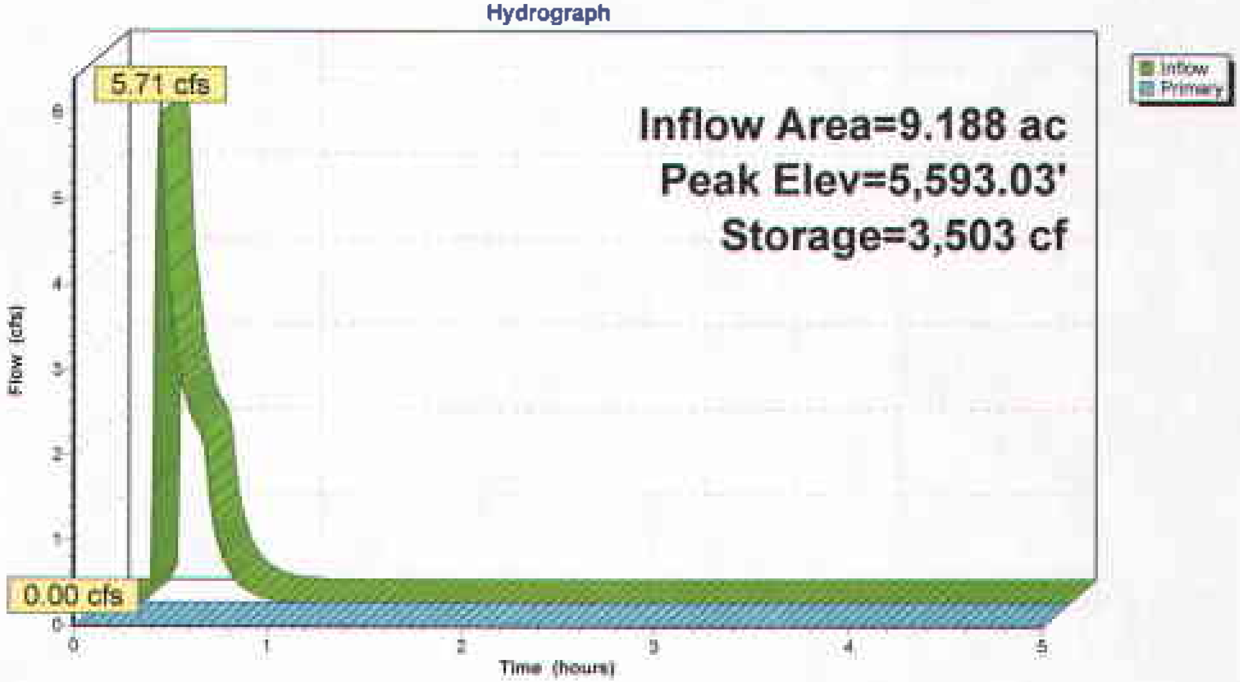
Volume	Invert	Avail.Storage	Storage Description
#1	5,591.00'	19,337 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

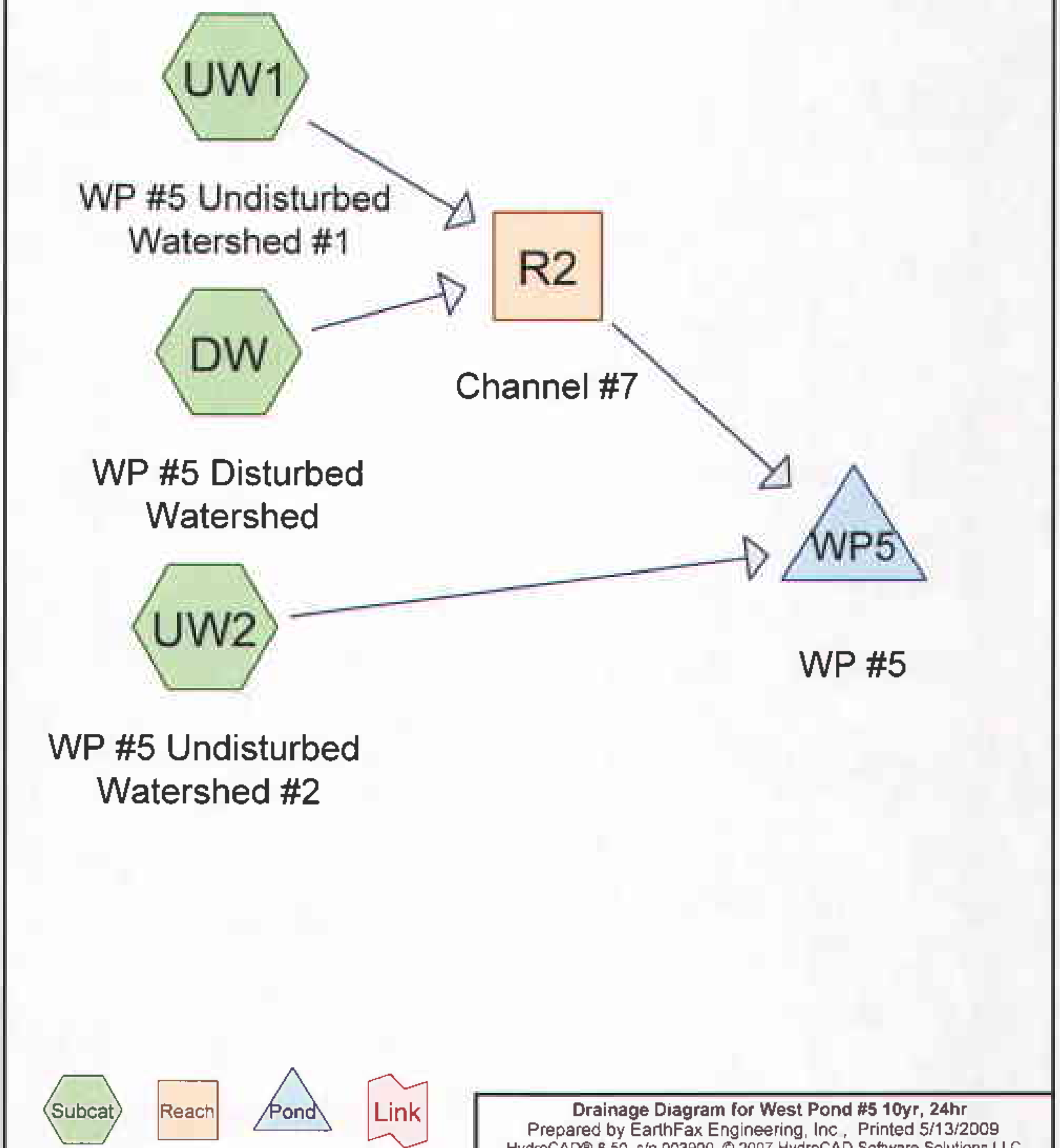
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,591.00	1,380	0	0
5,592.00	1,717	1,549	1,549
5,593.00	2,086	1,902	3,450
5,594.00	2,485	2,286	5,736
5,595.00	2,915	2,700	8,436
5,596.00	3,377	3,146	11,582
5,597.00	3,870	3,624	15,205
5,598.00	4,394	4,132	19,337

Device	Routing	Invert	Outlet Devices
#1	Primary	5,596.00'	**Special & User-Defined** Head (feet) 0.00 0.21 Disch. (cfs) 0.000 2.990

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5,591.00' (Free Discharge)
└1=**Special & User-Defined** (Controls 0.00 cfs)

Pond WP4: WP #4


Hydrograph
5.71 cfs
0.00 cfs
Inflow Area=9.188 ac
Peak Elev=5,593.03'
Storage=3,503 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6



Drainage Diagram for West Pond #5 10yr, 24hr
Prepared by EarthFax Engineering, Inc , Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW: WP #5 Disturbed Runoff Area=3.240 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=260' Slope=0.3850 '/' Tc=1.6 min CN=82 Runoff=3.02 cfs 0.132 af

Subcatchment UW1: WP #5 Undisturbed Runoff Area=0.900 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=285' Slope=0.5440 '/' Tc=2.3 min CN=67 Runoff=0.06 cfs 0.008 af

Subcatchment UW2: WP #5 Undisturbed Runoff Area=3.603 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=710' Slope=0.5000 '/' Tc=4.9 min CN=67 Runoff=0.20 cfs 0.031 af

Reach R2: Channel #7 Avg. Depth=0.41' Max Vel=8.61 fps Inflow=3.10 cfs 0.140 af
n=0.022 L=825.0' S=0.1539 '/' Capacity=31.00 cfs Outflow=2.73 cfs 0.140 af

Pond WP5: WP #5 Peak Elev=5,588.85' Storage=7,446 cf Inflow=2.86 cfs 0.171 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 7.743 ac Runoff Volume = 0.171 af Average Runoff Depth = 0.26"
100.00% Pervious = 7.743 ac 0.00% Impervious = 0.000 ac

Summary for Reach R2: Channel #7

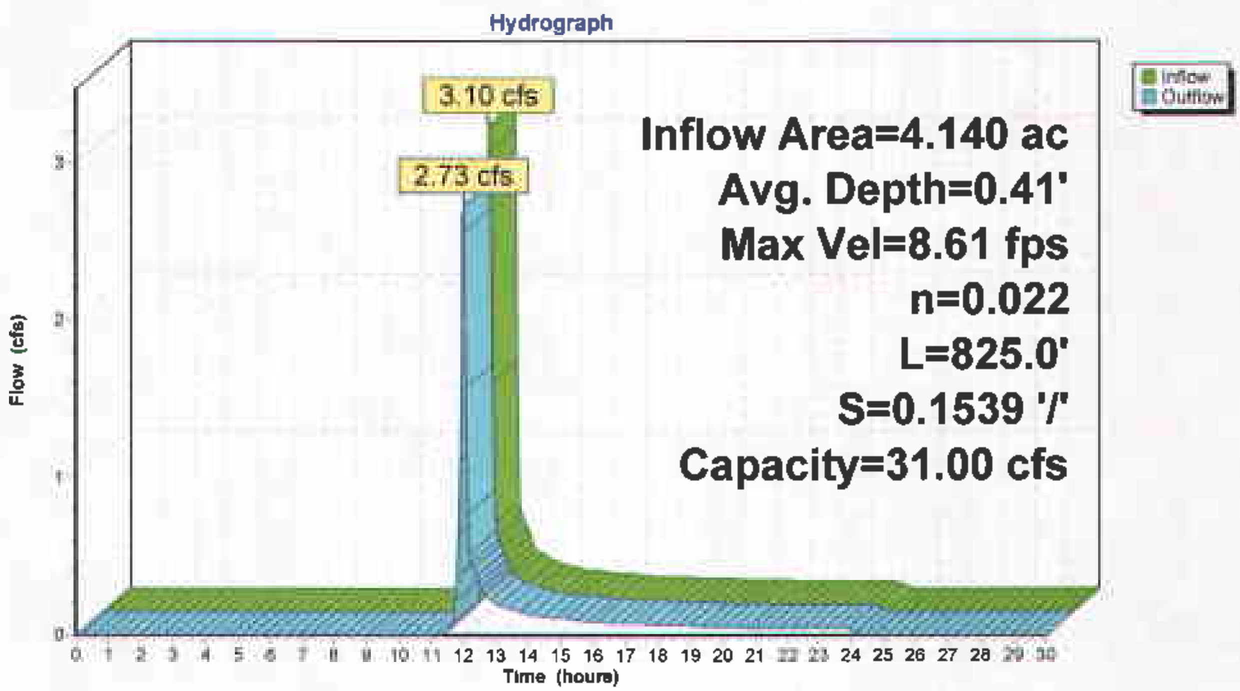
Inflow Area = 4.140 ac, 0.00% Impervious, Inflow Depth = 0.41"
Inflow = 3.10 cfs @ 11.93 hrs, Volume= 0.140 af
Outflow = 2.73 cfs @ 11.97 hrs, Volume= 0.140 af, Atten= 12%, Lag= 2.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.61 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 3.40 fps, Avg. Travel Time= 4.0 min

Peak Storage= 284 cf @ 11.94 hrs, Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 31.00 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 825.0' Slope= 0.1539 '/'
Inlet Invert= 5,732.00', Outlet Invert= 5,605.00'

Reach R2: Channel #7



Summary for Pond WP5: WP #5

Inflow Area = 7.743 ac, 0.00% Impervious, Inflow Depth = 0.26"
Inflow = 2.86 cfs @ 11.98 hrs, Volume= 0.171 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 5,588.85' @ 30.00 hrs Surf.Area= 2,338 sf Storage= 7,446 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

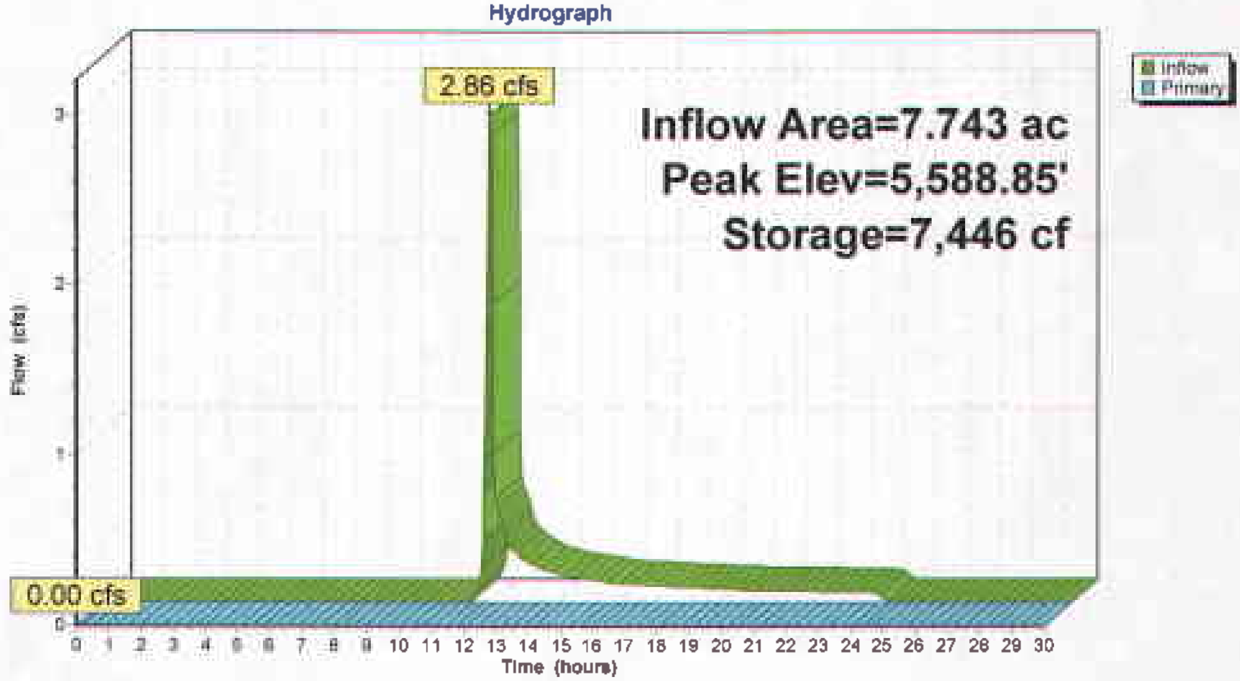
Volume	Invert	Avail.Storage	Storage Description
#1	5,584.00'	11,849 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

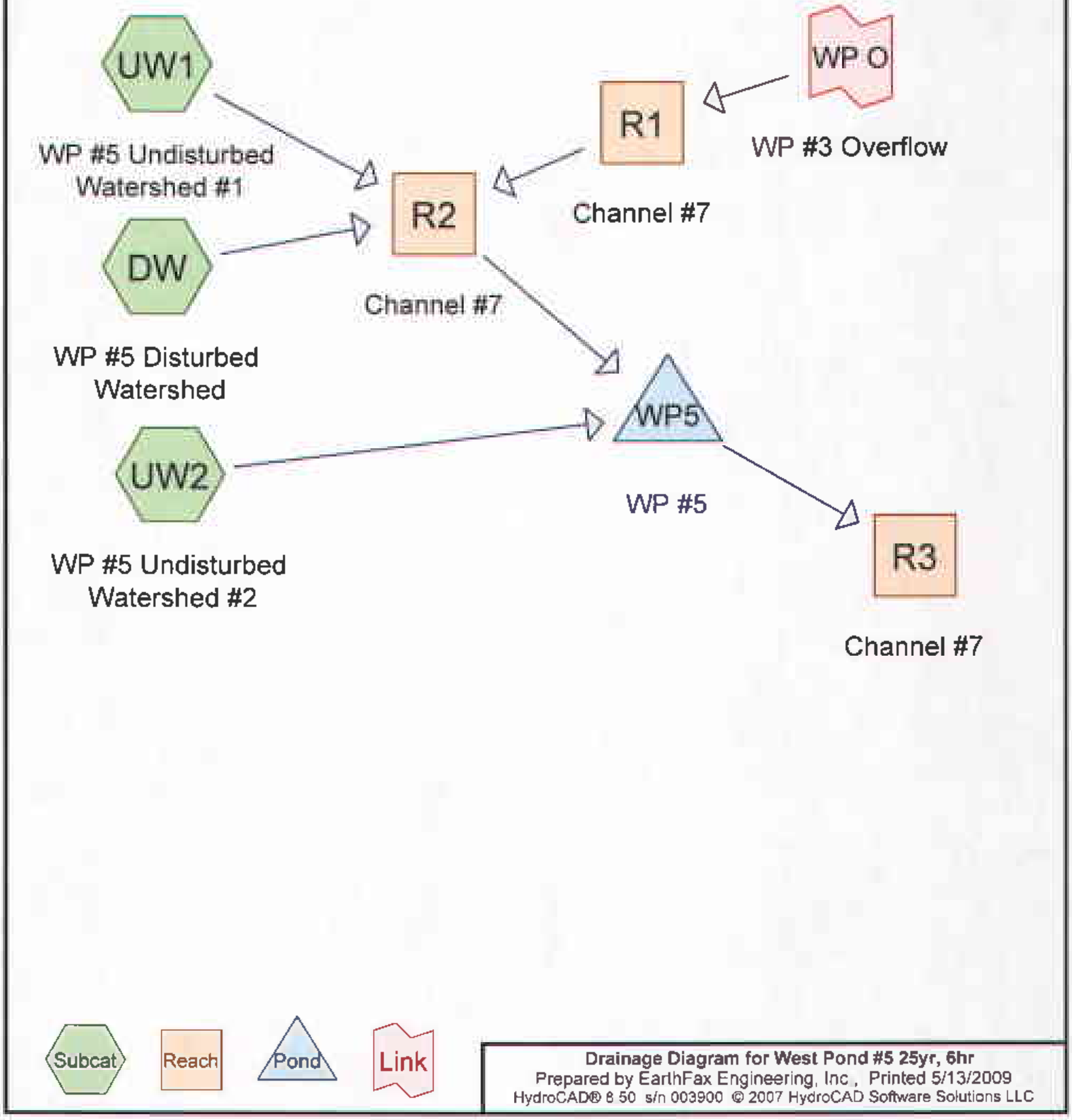
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,584.00	851	0	0
5,585.00	1,098	975	975
5,586.00	1,377	1,238	2,212
5,587.00	1,686	1,532	3,744
5,588.00	2,025	1,856	5,599
5,589.00	2,395	2,210	7,809
5,590.00	2,795	2,595	10,404
5,590.50	2,985	1,445	11,849

Device	Routing	Invert	Outlet Devices
#1	Primary	5,589.00'	**Special & User-Defined** Head (feet) 0.00 0.32 Disch. (cfs) 0.000 1.700

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5,584.00' (Free Discharge)
└─**1=Special & User-Defined** (Controls 0.00 cfs)

Pond WP5: WP #5


Hydrograph
2.86 cfs
0.00 cfs
Inflow Area=7.743 ac
Peak Elev=5,588.85'
Storage=7,446 cf
Inflow
Primary
Flow (cfs)
0
1
2
3
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Time (hours)



Drainage Diagram for West Pond #5 25yr, 6hr
Prepared by EarthFax Engineering, Inc , Printed 5/13/2009
HydroCAD® 8 50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-12.00 hrs, dt=0.05 hrs, 241 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW: WP #5 Disturbed Runoff Area=3.240 ac 0.00% Impervious Runoff Depth=0.30"
Flow Length=260' Slope=0.3850 '/' Tc=1.6 min CN=82 Runoff=4.75 cfs 0.080 af

Subcatchment UW1: WP #5 Undisturbed Runoff Area=0.900 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=285' Slope=0.5440 '/' Tc=2.3 min CN=67 Runoff=0.01 cfs 0.003 af

Subcatchment UW2: WP #5 Undisturbed Runoff Area=3.603 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=710' Slope=0.5000 '/' Tc=4.9 min CN=67 Runoff=0.05 cfs 0.010 af

Reach R1: Channel #7 Avg. Depth=0.28' Max Vel=8.65 fps Inflow=1.36 cfs 0.154 af
n=0.022 L=276.0' S=0.2609 '/' Capacity=18.74 cfs Outflow=1.36 cfs 0.154 af

Reach R2: Channel #7 Avg. Depth=0.48' Max Vel=7.94 fps Inflow=4.75 cfs 0.237 af
n=0.022 L=583.0' S=0.1166 '/' Capacity=26.98 cfs Outflow=3.13 cfs 0.237 af

Reach R3: Channel #7 Avg. Depth=0.44' Max Vel=4.31 fps Inflow=1.70 cfs 0.247 af
n=0.022 L=57.0' S=0.0351 '/' Capacity=14.80 cfs Outflow=1.70 cfs 0.247 af

Pond WP5: WP #5 Peak Elev=5,589.32' Storage=788 cf Inflow=3.13 cfs 0.247 af
Outflow=1.70 cfs 0.247 af

Link WP O: Primary Outflow Imported from West Pond #3 25yr, 6hr~Pond WP3.hce Inflow=1.36 cfs 0.154 af
Area= 21.919 ac Primary=1.36 cfs 0.154 af

Total Runoff Area = 7.743 ac Runoff Volume = 0.093 af Average Runoff Depth = 0.14"
100.00% Pervious = 7.743 ac 0.00% Impervious = 0.000 ac

Summary for Reach R1: Channel #7

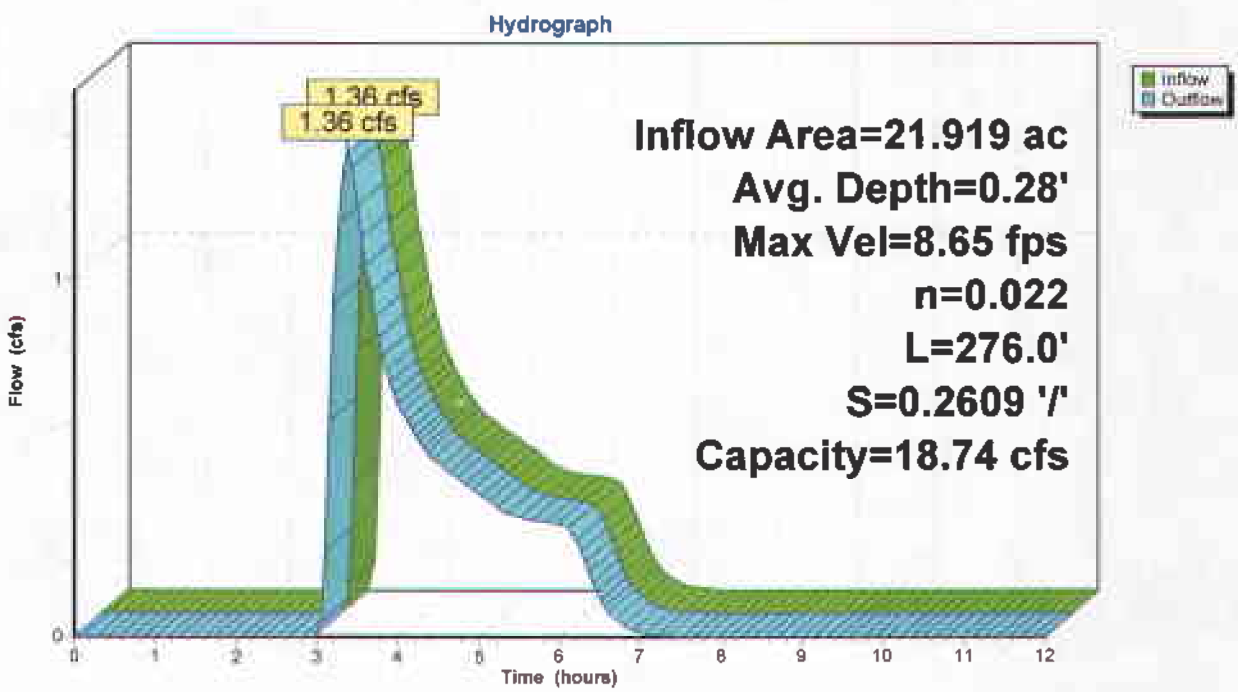
Inflow Area = 21.919 ac, 0.00% Impervious, Inflow Depth = 0.08"
Inflow = 1.36 cfs @ 3.35 hrs, Volume= 0.154 af
Outflow = 1.36 cfs @ 3.37 hrs, Volume= 0.154 af, Atten= 0%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.65 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 4.75 fps, Avg. Travel Time= 1.0 min

Peak Storage= 44 cf @ 3.36 hrs, Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 18.74 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 276.0' Slope= 0.2609 '/'
Inlet Invert= 5,732.00', Outlet Invert= 5,660.00'

Reach R1: Channel #7



Summary for Reach R2: Channel #7

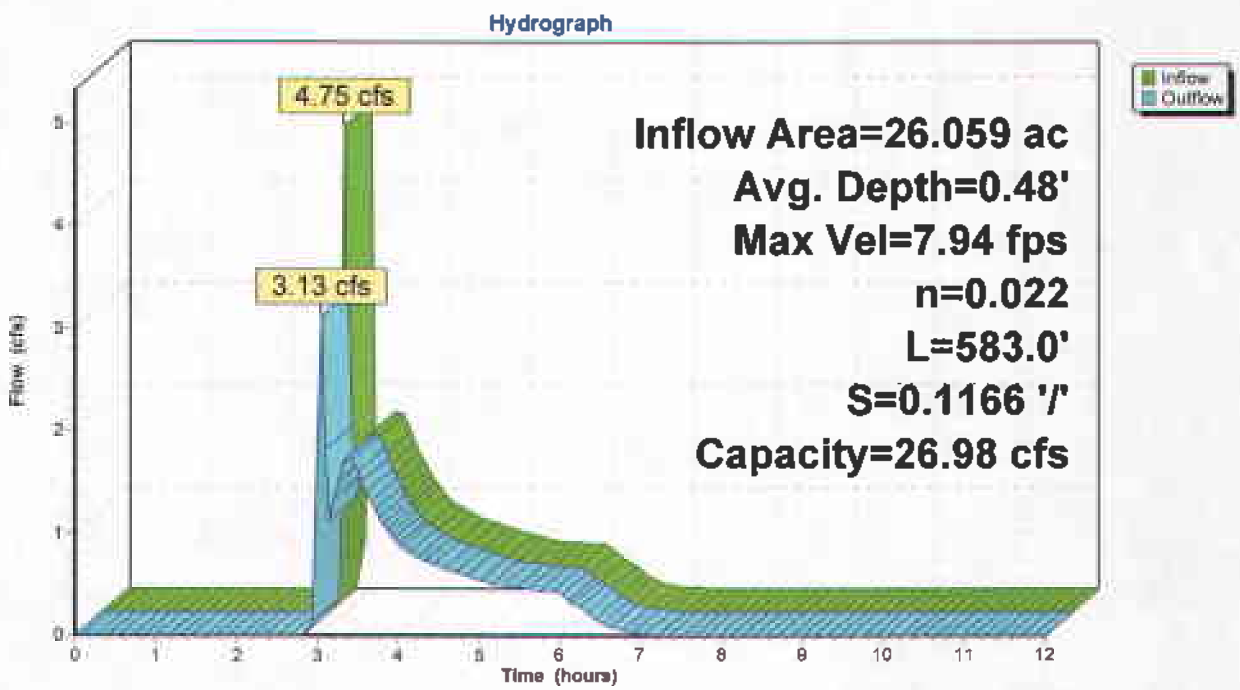
Inflow Area = 26.059 ac, 0.00% Impervious, Inflow Depth = 0.11"
Inflow = 4.75 cfs @ 3.00 hrs, Volume= 0.237 af
Outflow = 3.13 cfs @ 3.05 hrs, Volume= 0.237 af, Atten= 34%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.94 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 3.64 fps, Avg. Travel Time= 2.7 min

Peak Storage= 257 cf @ 3.02 hrs, Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 26.98 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 583.0' Slope= 0.1166 '/'
Inlet Invert= 5,659.00', Outlet Invert= 5,591.00'

Reach R2: Channel #7



Summary for Reach R3: Channel #7

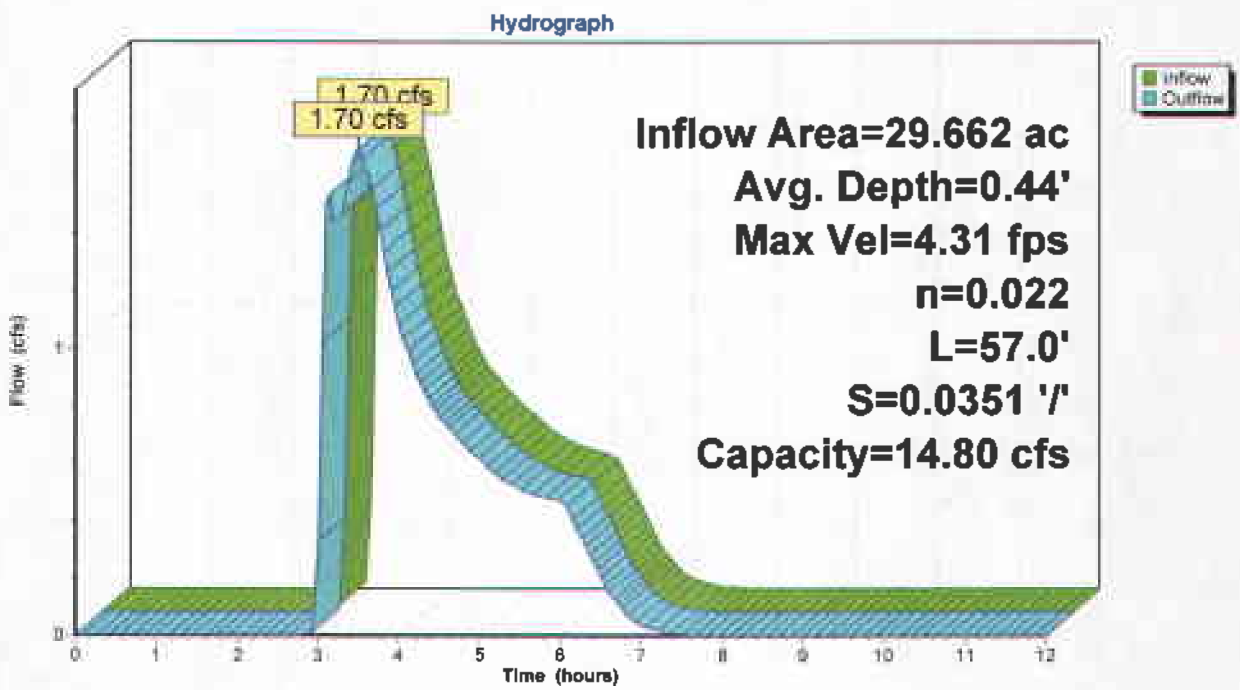
Inflow Area = 29.662 ac, 0.00% Impervious, Inflow Depth = 0.10"
Inflow = 1.70 cfs @ 3.48 hrs, Volume= 0.247 af
Outflow = 1.70 cfs @ 3.49 hrs, Volume= 0.247 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.31 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.25 fps, Avg. Travel Time= 0.4 min

Peak Storage= 23 cf @ 3.48 hrs, Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 14.80 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 57.0' Slope= 0.0351 '/'
Inlet Invert= 5,582.00', Outlet Invert= 5,580.00'

Reach R3: Channel #7



Summary for Pond WP5: WP #5

Inflow Area = 29.662 ac, 0.00% Impervious, Inflow Depth = 0.10"
Inflow = 3.13 cfs @ 3.05 hrs, Volume= 0.247 af
Outflow = 1.70 cfs @ 3.48 hrs, Volume= 0.247 af, Atten= 46%, Lag= 26.0 min
Primary = 1.70 cfs @ 3.48 hrs, Volume= 0.247 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs
Peak Elev= 5,589.32' @ 3.48 hrs Surf.Area= 2,523 sf Storage= 788 cf

Plug-Flow detention time= 7.6 min calculated for 0.247 af (100% of inflow)
Center-of-Mass det. time= 7.6 min (258.7 - 251.1)

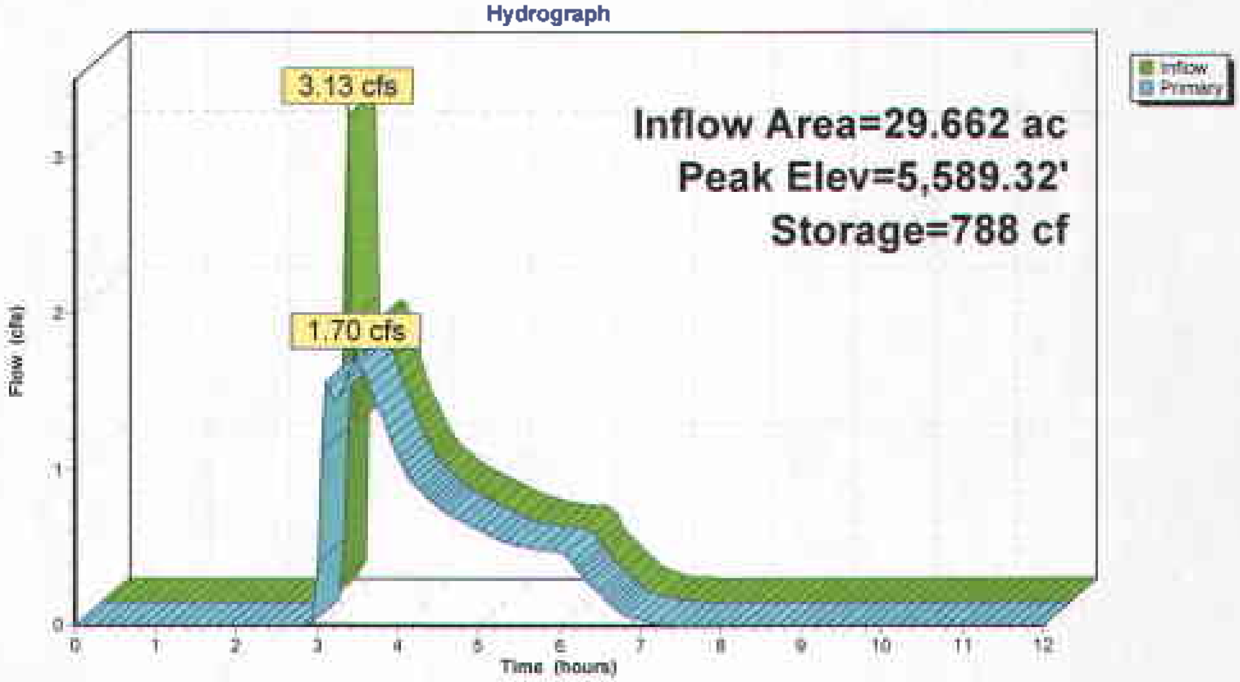
Volume	Invert	Avail.Storage	Storage Description
#1	5,584.00'	4,040 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,584.00	851	0.0	0	0
5,585.00	1,098	0.0	0	0
5,586.00	1,377	0.0	0	0
5,587.00	1,686	0.0	0	0
5,588.00	2,025	0.0	0	0
5,589.00	2,395	0.0	0	0
5,590.00	2,795	100.0	2,595	2,595
5,590.50	2,985	100.0	1,445	4,040

Device	Routing	Invert	Outlet Devices
#1	Primary	5,589.00'	**Special & User-Defined** Head (feet) 0.00 0.32 Disch. (cfs) 0.000 1.700

Primary OutFlow Max=1.70 cfs @ 3.48 hrs HW=5,589.32' (Free Discharge)
↑—**1=Special & User-Defined** (Custom Controls 1.70 cfs)

Pond WP5: WP #5


Hydrograph
3.13 cfs
1.70 cfs
Inflow Area=29.662 ac
Peak Elev=5,589.32'
Storage=788 cf
Inflow
Primary
Flow (cfs)
0
1
2
3
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
11
12

West Pond #5 Spillway Top
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	West Pond #5 Spillwa
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	150000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Bottom Width	1.00	ft
Discharge	1.70	cfs

Results		
Depth	0.25	ft
Flow Area	0.4	ft²
Wetted Perim	2.12	ft
Top Width	2.00	ft
Critical Depth	0.35	ft
Critical Slope	0.040497	ft/ft
Velocity	4.54	ft/s
Velocity Head	0.32	ft
Specific Energ	0.57	ft
Froude Numb	1.85	
Flow Type	Supercritical	

West Pond #5 Spillway Bottom
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	West Pond #5 Spillway
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	333000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Bottom Width	1.00	ft
Discharge	1.70	cfs

Results		
Depth	0.20	ft
Flow Area	0.3	ft²
Wetted Perim	1.90	ft
Top Width	1.81	ft
Critical Depth	0.35	ft
Critical Slope	0.040498	ft/ft
Velocity	6.02	ft/s
Velocity Head	0.56	ft
Specific Energ	0.76	ft
Froude Numb	2.68	
Flow Type	Supercritical	

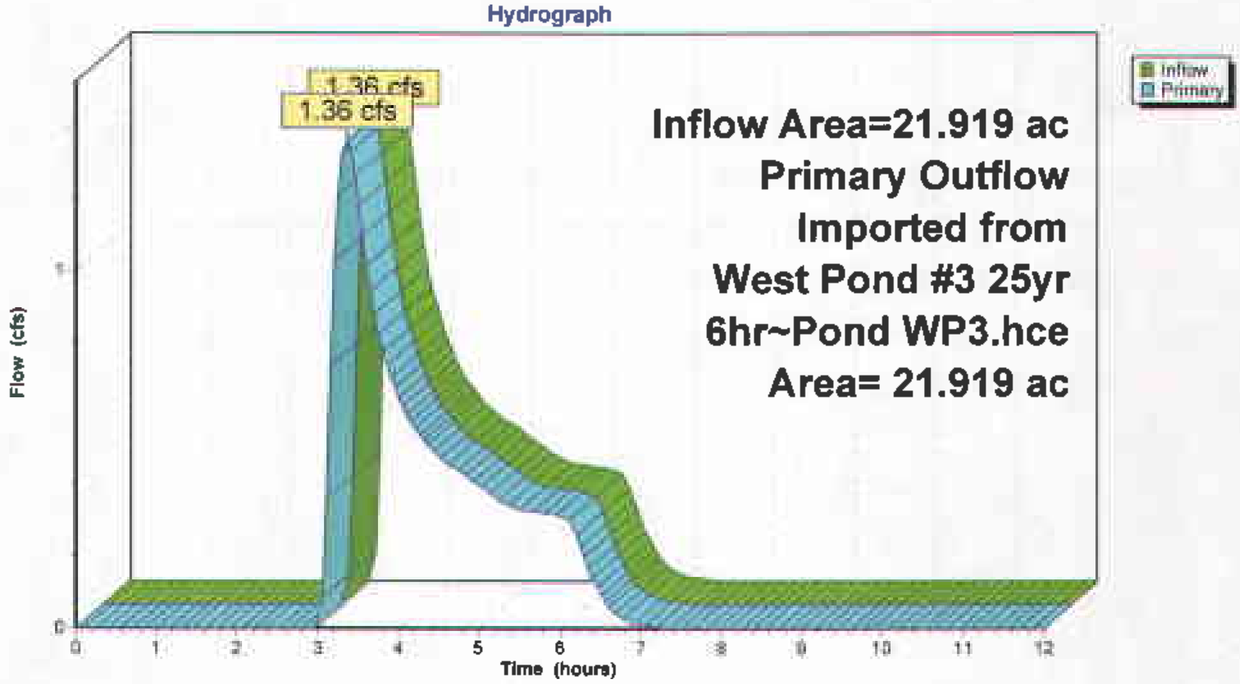
Summary for Link WP O: WP #3 Overflow

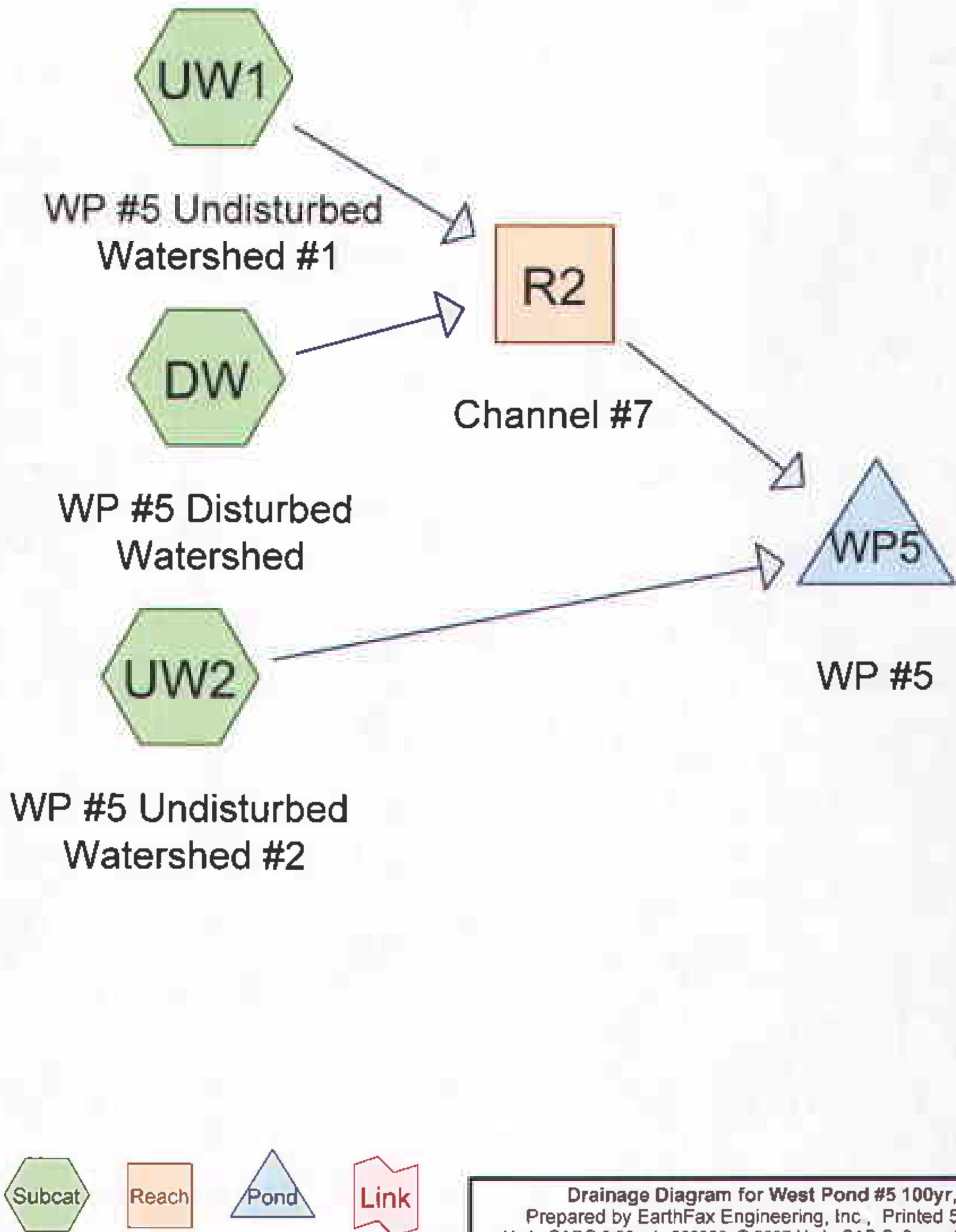
Inflow Area =	21.919 ac,	0.00% Impervious, Inflow Depth =	0.08"
Inflow =	1.36 cfs @	3.35 hrs, Volume=	0.154 af
Primary =	1.36 cfs @	3.35 hrs, Volume=	0.154 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-12.00 hrs, dt= 0.05 hrs

Primary Outflow Imported from West Pond #3 25yr, 6hr~Pond WP3.hce

Link WP O: WP #3 Overflow





Drainage Diagram for West Pond #5 100yr, 0.5hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-5.00 hrs, dt=0.01 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DW: WP #5 Disturbed Runoff Area=3.240 ac 0.00% Impervious Runoff Depth=0.21"
Flow Length=260' Slope=0.3850 '/' Tc=1.6 min CN=82 Runoff=10.22 cfs 0.057 af

Subcatchment UW1: WP #5 Undisturbed Runoff Area=0.900 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=285' Slope=0.5440 '/' Tc=2.3 min CN=67 Runoff=0.05 cfs 0.001 af

Subcatchment UW2: WP #5 Undisturbed Runoff Area=3.603 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=710' Slope=0.5000 '/' Tc=4.9 min CN=67 Runoff=0.21 cfs 0.003 af

Reach R2: Channel #7 Avg. Depth=0.55' Max Vel=10.43 fps Inflow=10.22 cfs 0.057 af
n=0.022 L=825.0' S=0.1539 '/' Capacity=31.00 cfs Outflow=6.28 cfs 0.057 af

Pond WP5: WP #5 Peak Elev=5,586.31' Storage=2,654 cf Inflow=6.28 cfs 0.061 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 7.743 ac Runoff Volume = 0.061 af Average Runoff Depth = 0.09"
100.00% Pervious = 7.743 ac 0.00% Impervious = 0.000 ac

Summary for Reach R2: Channel #7

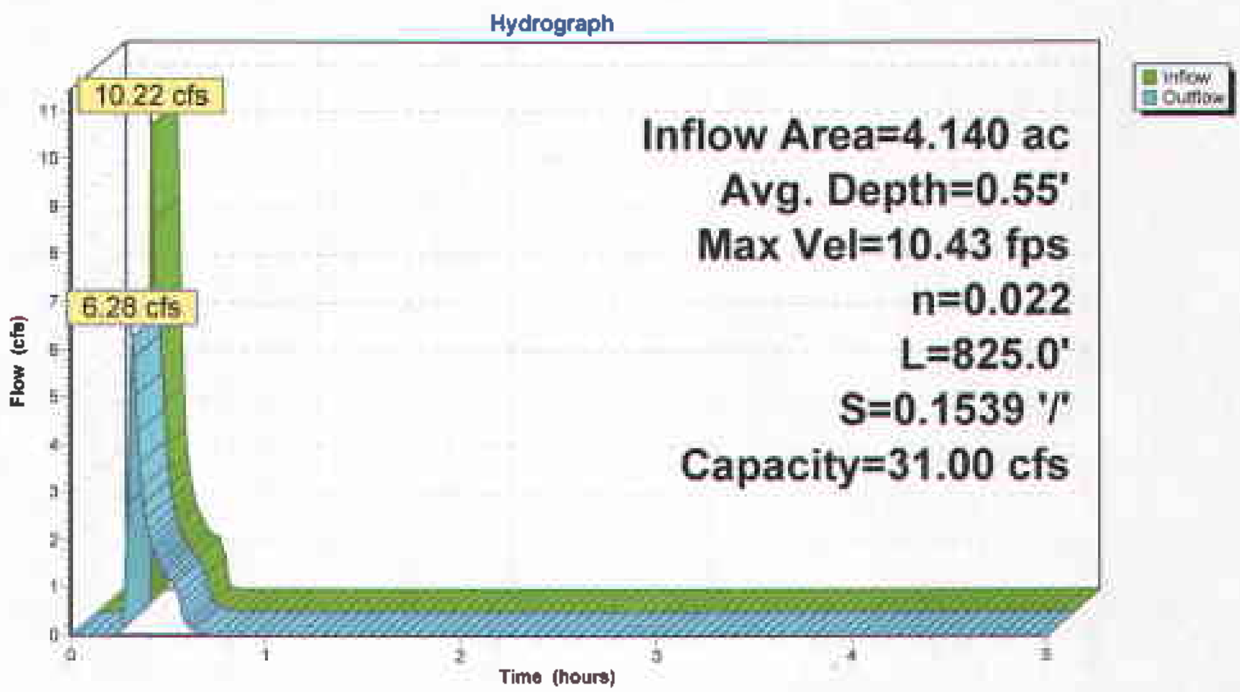
Inflow Area =	4.140 ac,	0.00% Impervious, Inflow Depth = 0.17"	
Inflow =	10.22 cfs @	0.27 hrs, Volume=	0.057 af
Outflow =	6.28 cfs @	0.31 hrs, Volume=	0.057 af, Atten= 39%, Lag= 2.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.43 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 2.91 fps, Avg. Travel Time= 4.7 min

Peak Storage= 503 cf @ 0.29 hrs, Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 31.00 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 825.0' Slope= 0.1539 '/'
Inlet Invert= 5,732.00', Outlet Invert= 5,605.00'

Reach R2: Channel #7



Summary for Pond WP5: WP #5

Inflow Area = 7.743 ac, 0.00% Impervious, Inflow Depth = 0.09"
Inflow = 6.28 cfs @ 0.31 hrs, Volume= 0.061 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Peak Elev= 5,586.31' @ 5.00 hrs Surf.Area= 1,473 sf Storage= 2,654 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

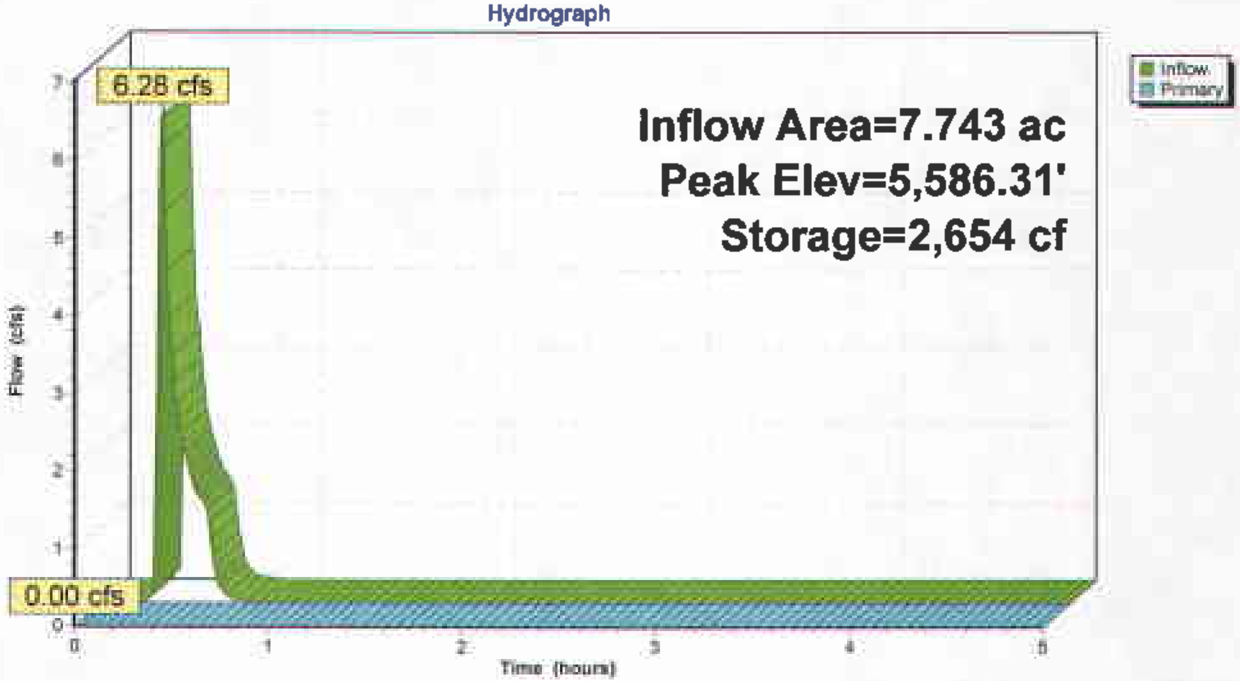
Volume	Invert	Avail.Storage	Storage Description
#1	5,584.00'	11,849 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,584.00	851	0	0
5,585.00	1,098	975	975
5,586.00	1,377	1,238	2,212
5,587.00	1,686	1,532	3,744
5,588.00	2,025	1,856	5,599
5,589.00	2,395	2,210	7,809
5,590.00	2,795	2,595	10,404
5,590.50	2,985	1,445	11,849

Device	Routing	Invert	Outlet Devices
#1	Primary	5,589.00'	**Special & User-Defined** Head (feet) 0.00 0.32 Disch. (cfs) 0.000 1.700

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=5,584.00' (Free Discharge)
└─**1=Special & User-Defined** (Controls 0.00 cfs)

Pond WP5: WP #5


Hydrograph
6.28 cfs
0.00 cfs
Inflow Area=7.743 ac
Peak Elev=5,586.31'
Storage=2,654 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7

APPENDIX 109-2

GOLDEN EAGLE MONITORING PLAN

THREATENED, ENDANGERED, AND SENSITIVE SPECIES

LETTER FROM

MT. NEBO SCIENTIFIC, INC.

(SEE APPENDIX106-2)

Golden Eagle Monitoring Plan
Chicken Creek Mine
September 2002
Revised September 9, 2002

Overview
All known nests within ½ mile[1] of mining operations will be monitored to determine if they are tended and active. Active nests will be monitored to determine how nesting eagles respond to mining operations, and to instill appropriate mitigation measures if negative responses are observed. Attempts will also be made to locate new nests within ½ mile radius of mining operations.

Protocol
These protocols will remain in effect through the active life of the mine unless modified through consultation with USFWS and UDWR.

Tended/Untended nest status will be determined by:

- Observing (monitoring) known nests for one week during the courtship/nest building stage[2,3]. Each observation day will be at least 4 hours in duration. If occupancy is not detected during these efforts, two additional observations of one week each will occur during the incubation period. A nest will be considered tended if: (1) recent nest materials (e.g., green branches) are observed, or (2) an adult eagle is perched on the nest or nest cliff during the courtship/nest building period.

All tended nests will be further monitored to determine active/inactive status. An active nest is defined as one that has an incubating adult present during the incubation period.

Observe (monitor) all active nests within ½ mile of operations during the following times:

- All daylight working hours of the first week of new activity initiation (i.e., drilling, blasting, excavating, trucking). This would ensure that specific activity types are monitored for a reasonable period of time to detect a negative response

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[1]U.S. Fish and Wildlife Service. 1999. Utah field office guidelines for raptor protection from human and land use disturbances. Salt Lake City. 41pp.
[2] The number and duration of monitoring visits could be less if positive evidence is observed earlier.
[3] Nesting stage dates may vary between sites and years depending on various biotic and abiotic factors. However, according to data obtained by the UDWR in their Southwestern Region, most golden eagle nests fall within the range of dates provided below:

- Courtship / Nest Building: February 1 – March 1
- Laying / Incubation: March 1 – April 30 (average laying date is 3/15)
- Nestling: April 15 – July 31 (hatching is concentrated between late April and mid May)
- Fledgling: July 1 – July 31 (August 4th is latest known date)

by golden eagles. Should it be determined through monitoring that nesting eagles are adversely affected (courtship and nesting behavior), UDWR and USFWS will be consulted to finalize an appropriate mitigation plan, including appropriate seasons of operation. This monitoring would occur each year that the mine is active.

- A four hour period during each of the major nesting stages (i.e., incubation, nestling, and fledgling), during mining operations. This would provide information on nest status and productivity. This type of monitoring should occur each year during the active life of the mine.

- Request that the operator only blast between October 1 and January 15.

Trigger points for re-evaluating mining operations and consulting the FWS and UDWR are:

- Adults do not return to nest with eggs or young under two weeks of age for a period of $\geq$ 4 hours.

- Adults &/or chicks show obvious stress symptoms during the activity, and the reaction could result in loss of eggs, young, or adults. Examples include but are not limited to: (1) sudden movement by incubating adult that could jostle eggs, or (2) movements by young that indicate premature fledging could occur.

Inventories for new nests will be conducted annually within ½ mile radius of mining operations. Searches will concentrate on suitable nest cliffs, and will be primarily ground-based with use binoculars and spotting scopes. Searches will be conducted during the courtship/nest building period, and will only occur during years when mining is occurring.

All monitoring data will be recorded in a time-line format that captures mining activities and eagle behavior, regardless of whether there appears to be a cause and effect relationship. Monitoring will primarily be ground-based, with use binoculars and spotting scopes.

All monitoring will be conducted by a qualified biologist of the Forest Service, UDWR, FWS, or contractor. Contract biologists must be approved by the Forest Service.

/s/ Elaine J. Zieroth

APPENDIX 109-4
AIR QUALITY PERMIT AND
BLASTING OPERATIONS/PROCEDURES

SUNROC
BLASTING OPERATIONS/PROCEDURES
LEVAN, UTAH QUARRY

The following information is a summary for the operations, procedures, handling, storing, transportation and use of explosives, methods for alerting and informing the general public and affected persons of the blast schedule and exclusion from the blast zone.

Requirement. In addition to the requirements of this section, the transportation, handling, storage and use of explosives shall be subject to provisions of Subpart U, "Blasting and use of Explosives, of 29 CFR Part 1926 and Section 109, "Explosives and Blasting Agents", of 29 CFR 1910, regulations of the Dept. Of the Treasury contained in 27 CFR Part 55, " Commerce in Explosives, Dept. Of Labor 30 CFR Part 56 and 57, "Safety Standards for Explosives at Metal and Non Metal Mines". In case of conflict, the more stringent will prevail.

HANDLING OF EXPLOSIVES

All explosives will be handled by a competent, qualified blaster and/or blasting foreman. The blaster may allow other persons to handle explosives but only his direct supervision.Explosives will be handled in a safe manner at all times.

An inventory (ICS) of all explosives received, stored, removed, and returned to magazines shall be maintained and kept current at all times.

Permission shall be obtained prior to bringing any explosives or blasting agents on the jobsite.

Notification will be made to the client of pending blasting operations in the immediate vicinity of buildings, public roadways, overhead power lines, utility services or similar facilities and shall not undertaken until all necessary precautions are taken for safe control of the blasting oeprations.

Competent Supervision. The transportation, handling, loading, firing, storage and use of dynamite and other explosives, including blasting agents, shall be directed and supervised by persons of proven experience and competency in blasting and use of explosives.

Qualifications. A blaster shall be qualified, by reason of training, knowledge and experience, in the field of transporting, handling, storing and use of explosives and shall have a working knowledge of Federal, State and Local laws and regulations which pertain to explosives.

Persons under the influence of alcohol, drugs intoxicant or other type substance abuse are strictly prohibited from all company vehicles and work areas. A drug screening and active drug and alcohol policy will continue to be in effect, including random testing.

STORAGE OF EXPLOSIVES

Explosives will be stored on the project in approved magazines. The storage site be located as remotely as practical from existing structures and will be mutually agreed upon by the client and Blaster.

Approved magazines shall meet the specifications of MSHA and ATF. The ATF magazine rating will govern the type of explosives which may be stored in that magazine. The on site magazines shall be located in accordance with the American Table of Distance for Storage of Explosives. All applicable provisions of the ATF Manual Explosives Law and Regulations (ATF P 5400.7) will be followed. Bi lingual signs will be erected stating "EXPLOSIVES - KEEP OUT" and "NO SMOKING". The local fire department and law enforcement agencies will be notified of the storage location.

TRANSPORTATION OF EXPLOSIVES

Explosives will be transported from the manufacturer and/or dealer magazines to our storage magazines by the manufacturer and/or dealer. Explosives will be transported to the blast site from our storage magazine by Wolfe Blasting, Inc. personnel. All DOT regulations shall be complied with during the transportation of explosives on public roadways. Under all circumstances, jobsite transportation will comply with OSHA Standard 29 CFR 1926.902, "Surface Transportation of Explosives", and MSHA Standards .6040 to .6065.

Company vehicles used in transportation of explosives will be substantial, strong and in proper working order, equipped with a tight door of non sparking material. The vehicle will be equipped with sides that are sufficiently high enough to prevent explosives from falling off or a closed body. All sparking metal in the body likely to come in contact with explosives shall be covered with wood or other no sparking material. Compliance to all Federal, State and Local regulations will be met before undertaking the transportation of explosives.

Explosives shall not be transported in the same vehicle with detonators unless the detonators are carried in a separate approved container.

Trucks transporting explosives shall be in good condition and equipped with 2 approved fire extinguishers having a combined capacity of 4-1; 20 BC or greater and will be located in areas readily accessible.

Vehicles transporting explosives shall not be loaded beyond the manufacturer's safe capacity rating. Explosives shall not be stacked higher than the closed sides and ends of the body.

While transporting explosives, congested traffic shall be avoided where possible and no unnecessary stops are to be made. If mechanical difficulties arise and the vehicle must be repaired, explosives will be transferred to an approved vehicle immediately.

USE OF EXPLOSIVES

Explosives will be used only by a competent, qualified blaster or helper under the direct supervision of the blaster.

LOADING

Use of explosives will conform to OSHA Standard 29 CFR 1926.905, " Loading of Explosives or Blasting Agents" and MSHA Standard .6090 to .6168

FIRING AND INSPECTION

Firing of the blast will conform to OSHA Standard 29 CFR 1926.909, " Firing the Blast" and other applicable standards. Inspection of the blast will conform to OSHA Standard 29 CFR 1926.910, " Inspection After the Blast" and other applicable standards. Prior to firing, all persons will be evacuated from the blasting zone and guards will be posted at the entrance to the blasting area. When the area is clear, a 5 minute warning will be sounded. If the area remains clear, a 1 minute warning will be sounded. After the shot, the Blaster will inspect the blast area and if safe the all clear signal will be sounded. Pedestrian and vehicle traffic will then be allowed through the area and workers allowed back into the blasting zone.

The aural blast warning consists of the separate signals:

5 minutes prior to blast	3 prolonged siren wales of 15 seconds each
1 minute prior to blast	A series of short siren wales
All Clear signal	1 prolonged siren wale

All persons and vehicles will be halted at a minimum of 1000 feet of the blast zone.

MISFIRES

Misfires will be handled by the blaster in accordance with OSHA Standard 29 CFR 1926.911, "Misfires and MSHA Standard .6168. If a misfire occurs no one will be allowed to enter the blast site for a period of 15 minutes following the misfired shot.

If a misfire occurs due to a cut off of surface initiation path to the blast hole, the cut off will be hooked up and the remaining blast fired. If a misfire occurs in a blasthole the stemming in the misfired blasthole will be flushed out and the blasthole will then be reprimed and shot. Under **NO** circumstances will known misfired holes be left unattended overnight or abandoned.

BLAST WARNING SIGNS

A bilingual sign will be erected stating the Blast Warning Signals. Temporary barricades (A frame type and pylons) will be used to identify the area being drilled and loaded for blasting.

Loaded bilingual signs will be used which state "LOADED BLAST KEEP OUT".

NOISE AND AIRBLAST CONTROL

Noise from blasting operations will be controlled by using proper blast design with adequate burden and spacing of blast holes. All blast holes will be adequately stemmed to properly confine the charges and resulting explosion. Delayed blasting will assist in the control of noise from the blast. Only "NON-ELECTRIC" caps will be used at the Levan Quarry. To reduce any noise or air blast to Levan City "NO" primer cord or surface cord will be used at either Quarry in Chicken Creek.

FLYROCK CONTROL

Wolfe Blasting, Inc. Will take particular care to control flyrock from blasting and shall modify the parameters of the blasting necessary to confine all such material as practical to the project site. Flyrock will be controlled by directing blast energy away from structures or areas of concern through the use of proper blast design, controlled loading and delaying, adequate stemming column and/or shooting into a shot rock burden.

Where possible, the direction of the throw will be controlled by delaying away from the nearest structure or area of concern. Existing dirt will be l eft on top of the blast to aid in flyrock control.

When using blasting mats, blasting mats will be placed in such a manner that they overlap each other by approximately 5 feet at adjoining areas. This will account for the swell of the shot and should prevent the mats from being pulled apart. When blasting into a shot rock burden, the blasting mats will overlap the face area by a distance of approximately burden distance plus 5 feet. Back row and side row(s) will lap 5 feet past the hole. Areas covered with dirt only will provide dirt cover that will extend 5 to 7 feet past the outside row of holes.

EXPLOSIVES USED

Non electric blasting caps, (NON-EL) will be used to initiate the primer in the blasthole and (EZTL) will be used on the surface. An electric cap wired in to a lead line then wired to a blasting machine will be used for shot detonation.

Dynamite or emulsion will be used as a primer for production and controlled balstholes. ANFO will be used as the blasting agent in any dry holes. Dynamite will be used as the blasting agent in wet holes.

Dyno Nobel and Austin Powder products will be used.

BLAST RECORDS

A blast record will be maintained for each blast that will include the following:
a. date of blast

b. time of blast
c. number of holes
d. type of explosive used
e. maximum amount of charge per delay
f. number of delays
g. stemming
h. number and type of caps.

A sketch of the blast location is attached to the report depicting the firing pattern and sequence.

VIBRATION AND MONITORING CONTROL

A full printed seismic report from a technically adequate seismograph is utilized. It will record 3 directions of ground vibration, longitudinal, vertical, and transverse as well as maximum noise level in decibels and also provides a peak vector sum that shall be applied when structural distances are mandated.

VCE a professional seismic monitoring company has reviewed the scale distances from plans provided by SUNROC, monitors placed at the closest home using .01 (which is the lowest setting) on the seismic monitor VCE feels there is ZERO chance of the monitor triggering. Aaron Jones from VCE has reviewed the plans and his number is 702-419-9210 please feel free to call his firm. Any technical data needed can be emailed or forwarded to the proper authorities.

NOTE: Because each blasting situation is different, the tentative blast design parameters are subject to change based on field conditions and data obtained from the on going blasting program.

IN HOUSE PROCEDURES

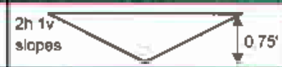
1. Blaster lays out pattern with driller and client specifications.
2. Blaster determines depth and sub drilling
3. Energetic material are properly separated and were previously recorded when received and stored in magazine.
4. Holes are drilled and taped. And logged on drill report for accurate depth and evidence of water and voids.
5. Energetic materials are retrieved from magazine and logged on Inventory Control Sheet.
6. Holes loaded by designated persons. Blaster supervises 2 helpers that are properly recorded with ATF.
7. Holes are retaped before loading.
8. Blaster inspects energetic materials for proper load.
9. Holes are loaded under supervision of blaster.
10. Inspection prior to tie in of shot. Inspection after all loads are tied in. Inspections conducted by Blaster and assistant.
11. All unused energetic materials removed to trailer.
12. Client is notified and blast time established. Area is cleared.
13. Barricades, cones and signs are placed. 5 min. warning prior to blast. 1 minute prior to blast. Blast site is walked to ensure area is clear. After blast, blast site is walked to ensure blast went according to plan and then all clear is sounded.
14. All unused energetic materials are returned to magazine.
15. Blast report completed.

APPENDIX 111-1

RECLAMATION HYDROLOGY CALCULATIONS

Reclamation Hydrology Calculation Summary
Chicken Creek Mine

Drainage Channel Parameters

Channel / Reach	X-section	100yr 0.5hr Max Flow (cfs)	Avg Slope (ft/ft)	Max Depth (ft)	Max Vel. (fps)	D_{50} Riprap (in)	Manning's n*
#1 / #1		1.71	0.2262	0.31	8.69	8	0.022
#2 / #1		2.78	0.1672	0.50	5.59	3	0.022
#2 / #2		2.66	0.0744	0.57	4.08	2	0.022
#3		0.44	0.2500	0.23	4.09	3	0.022
#4		0.49	0.3166	0.23	4.59	3	0.022
East #1		0.68	0.0732	0.23	4.19	2	0.022
East #2		1.6	0.0455	0.35	4.36	2	0.022
East #3		2.12	0.0429	0.40	4.58	2	0.022

*Adjusted for riprap size according to USDOT FHWA HEC No. 11 and NUREG/CR 4651 (see Appx 107-1)
$n = 0.0456 X (D_{50} X S)^{0.159}$ where D_{50} (inches) is the mean riprap diameter and S (ft/ft) is the channel slope

Calculations assume bottom of channel is graded at a relatively constant slope

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 39.525 N 111.913 W 5137 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006
Extracted: Tue May 19 2009

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Docs | Return to State Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.12	0.17	0.22	0.29	0.36	0.45	0.51	0.66	0.82	1.03	1.17	1.36	1.59	1.79	2.34	2.81	3.54	4.19
2	0.15	0.23	0.28	0.38	0.46	0.57	0.64	0.81	1.01	1.27	1.43	1.68	1.97	2.21	2.80	3.47	4.35	5.17
5	0.21	0.31	0.39	0.52	0.65	0.76	0.83	1.01	1.24	1.53	1.74	2.06	2.40	2.68	3.47	4.17	5.18	6.14
10	0.26	0.39	0.48	0.65	0.81	0.93	0.99	1.18	1.42	[illegible]	1.99	2.38	2.76	3.05	3.92	4.72	5.83	6.89
25	0.34	0.51	0.63	0.85	1.05	1.20	1.25	1.41	1.67	2.04	2.35	2.82	3.25	3.56	4.50	5.46	6.67	7.84
50	0.40	0.62	0.76	1.03	1.27	1.43	1.46	1.61	1.86	2.26	2.62	3.18	3.63	3.94	4.94	6.00	7.30	8.53
100	0.48	0.74	0.91	[illegible]	1.52	1.70	1.73	1.85	2.07	2.49	2.92	3.56	4.03	4.34	5.37	6.55	7.91	9.20
200	0.58	0.88	1.09	1.46	1.81	2.01	2.04	2.12	2.31	2.72	3.22	3.96	4.43	4.73	5.78	7.10	8.51	9.85
500	0.72	1.09	1.36	1.83	2.26	2.49	2.52	2.61	2.76	3.03	3.63	4.50	4.98	5.26	6.32	7.80	9.27	10.65
1000	0.85	1.29	1.60	2.15	2.66	2.93	2.96	3.04	3.17	3.26	3.95	4.95	5.41	5.67	6.71	8.32	9.82	11.22

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

* Upper bound of the 90% confidence interval
Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.14	0.21	0.26	0.34	0.42	0.52	0.58	0.73	0.91	1.11	1.25	1.47	1.71	1.92	2.50	3.01	3.76	4.46
2	0.17	0.26	0.33	0.44	0.55	0.66	0.75	0.91	1.12	1.36	1.55	1.81	2.12	2.38	3.08	3.72	4.64	5.51
5	0.24	0.37	0.46	0.61	0.76	0.88	0.94	1.13	1.36	1.65	1.87	2.21	2.57	2.87	3.71	4.47	5.53	6.55
10	0.30	0.46	0.57	0.77	0.95	1.07	1.13	1.31	1.56	1.88	2.14	2.55	2.95	3.27	4.18	5.06	6.22	7.35
25	0.39	0.60	0.74	1.00	1.24	1.38	1.42	1.58	1.84	2.19	2.53	3.03	3.47	3.81	4.81	5.85	7.12	8.37
50	0.48	0.73	0.90	1.21	1.50	1.66	1.67	1.82	2.07	2.43	2.83	3.42	3.89	4.23	5.29	6.45	7.80	9.11
100	0.58	0.88	1.09	1.46	1.81	1.99	2.01	2.10	2.31	2.68	3.15	3.83	4.32	4.60	5.75	7.04	8.47	9.84
200	0.69	1.05	1.30	1.75	2.17	2.37	2.40	2.44	2.61	2.94	3.48	4.27	4.77	5.10	6.21	7.64	9.13	10.56
500	0.88	1.34	1.66	2.23	2.76	3.00	3.02	3.05	3.16	3.29	3.95	4.89	5.38	5.69	6.82	8.44	9.99	11.46
1000	1.05	1.59	1.98	2.66	3.30	3.58	3.62	3.65	3.67	3.71	4.32	5.40	5.88	6.16	7.28	9.03	10.63	12.12

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

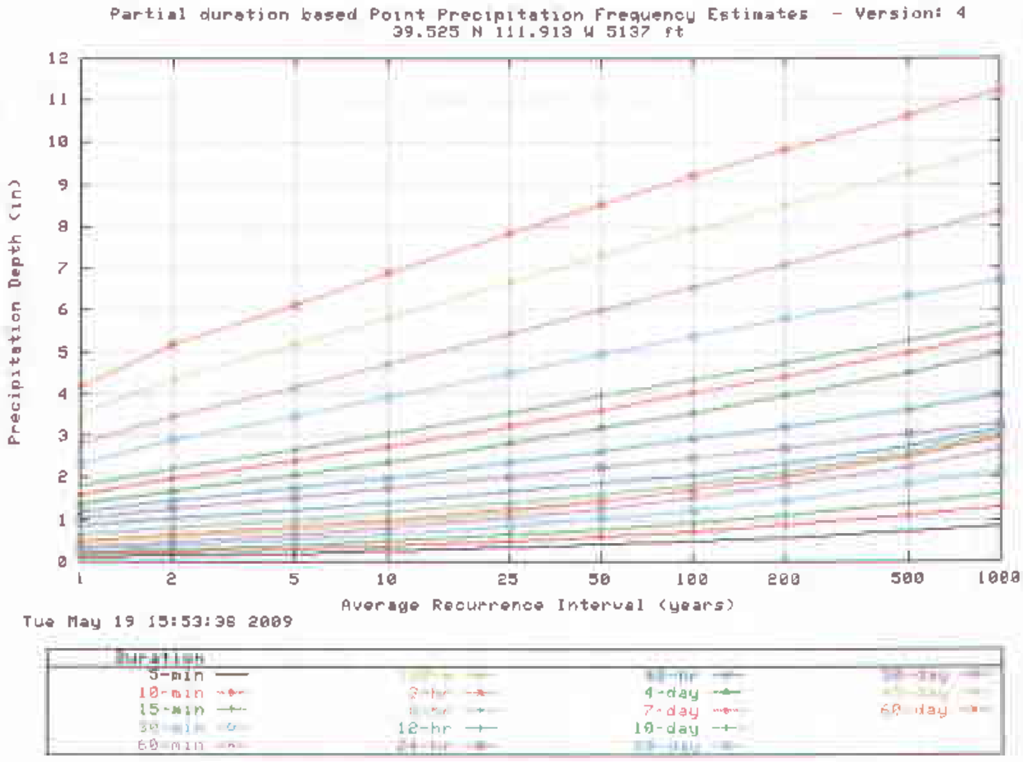
* Lower bound of the 90% confidence interval
Precipitation Frequency Estimates (inches)

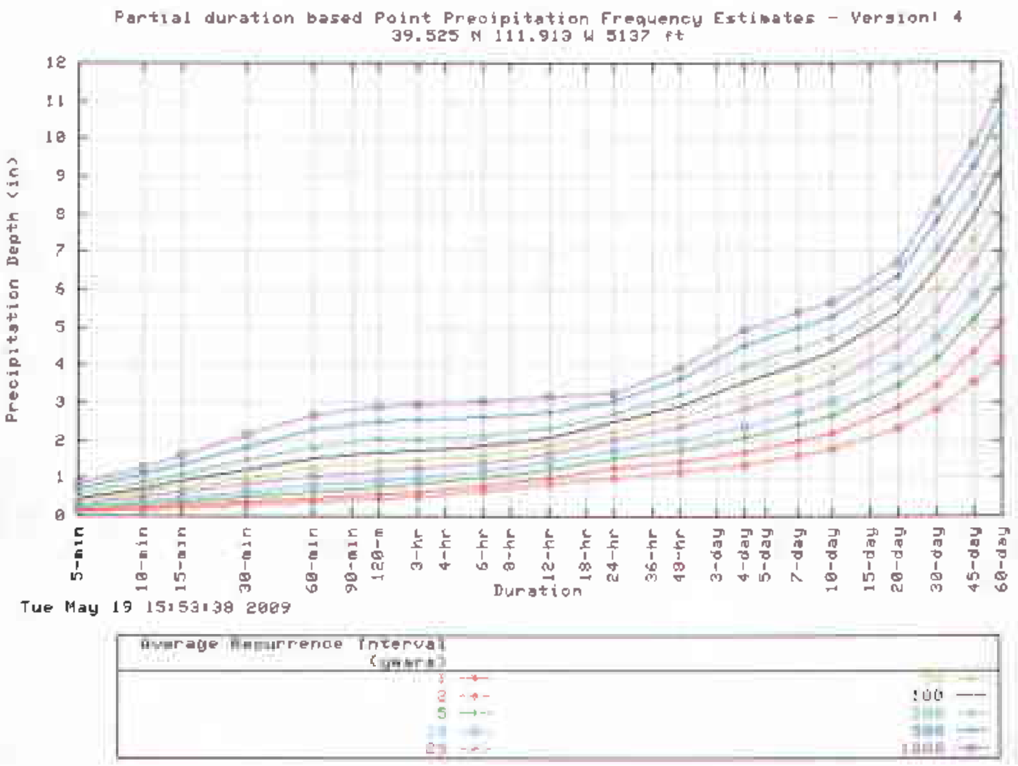
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.10	0.15	0.19	0.25	0.31	0.40	0.46	0.59	0.76	0.96	1.09	1.27	1.50	1.67	2.20	2.63	3.32	3.94
2	0.13	0.20	0.24	0.33	0.40	0.51	0.57	0.74	0.93	1.18	1.34	1.57	1.85	2.07	2.71	3.24	4.09	4.86
5	0.18	0.27	0.33	0.45	0.56	0.67	0.74	0.91	1.13	1.43	1.62	1.92	2.24	2.50	3.25	3.88	4.86	5.77
10	0.22	0.33	0.41	0.56	0.69	0.81	0.88	1.06	1.29	1.63	1.86	2.21	2.57	2.84	3.67	4.39	5.46	6.46
25	0.28	0.42	0.51	0.71	0.88	1.02	1.09	1.25	1.51	1.89	2.18	2.61	3.02	3.31	4.21	5.06	6.24	7.34
50	0.33	0.50	0.62	0.84	1.04	1.20	1.25	1.42	1.67	2.09	2.42	2.92	3.36	3.65	4.60	5.55	6.80	7.96
100	0.39	0.59	0.73	0.98	1.22	1.39	1.45	1.60	1.83	2.29	2.67	3.24	3.71	3.99	4.98	6.04	7.35	8.56
200	0.45	0.68	0.85	1.14	1.41	1.59	1.68	1.81	2.02	2.49	2.93	3.58	4.05	4.33	5.34	6.51	7.86	9.13
500	0.54	0.82	1.01	1.36	1.69	1.90	2.00	2.16	2.36	2.75	3.27	4.03	4.50	4.77	5.80	7.09	8.51	9.81
1000	0.61	0.93	1.15	1.55	1.92	2.15	2.27	2.46	2.67	2.94	3.52	4.37	4.83	5.10	6.12	7.52	8.97	10.28

* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.

* These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Text version of tables





Maps -

These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server.

Please read disclaimer for more information.

Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; **USGS Aerial Photograph** may also be available from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study, please refer to NOAA Atlas 14 Document.

Using the National Climatic Data Center's (NCDC) station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (39.525/-111.913). Digital ASCII data can be obtained directly from NCDC.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the Western Regional Climate Center's state-specific SNOTEL station maps.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910
(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

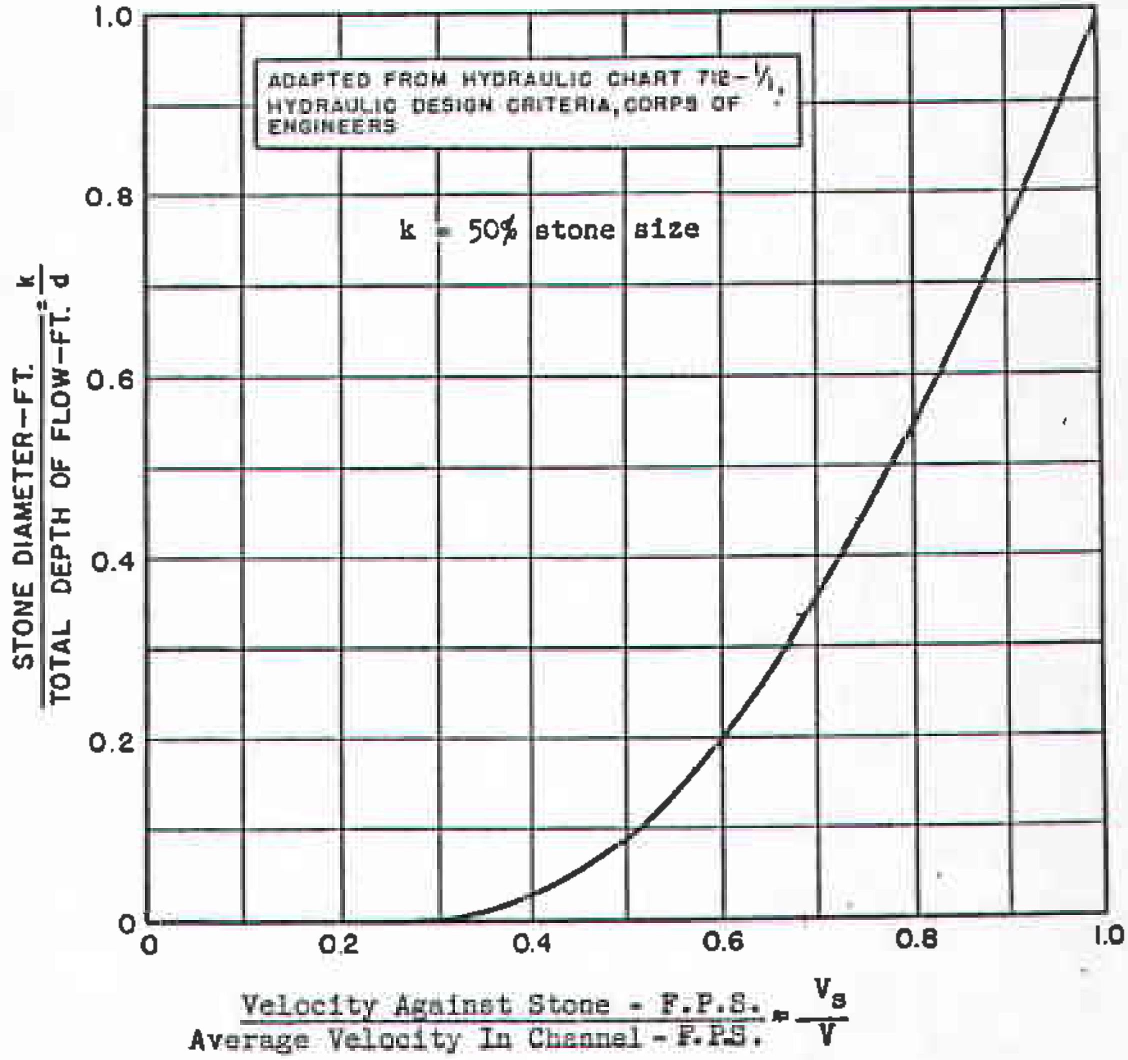


FIGURE 5-1 Velocity Against Stone on Channel Bottom (U.S. Department of Transportation, 1978).

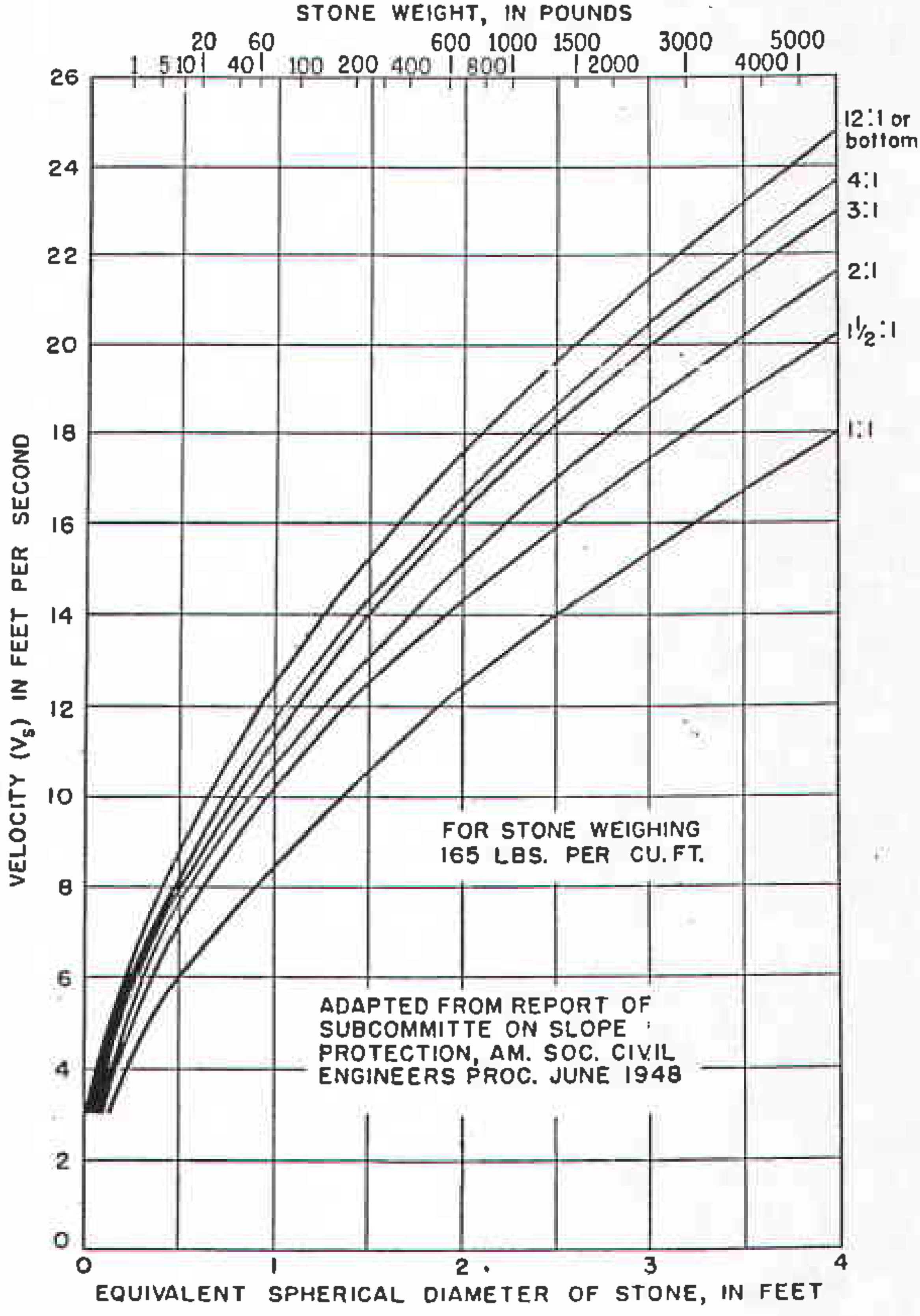
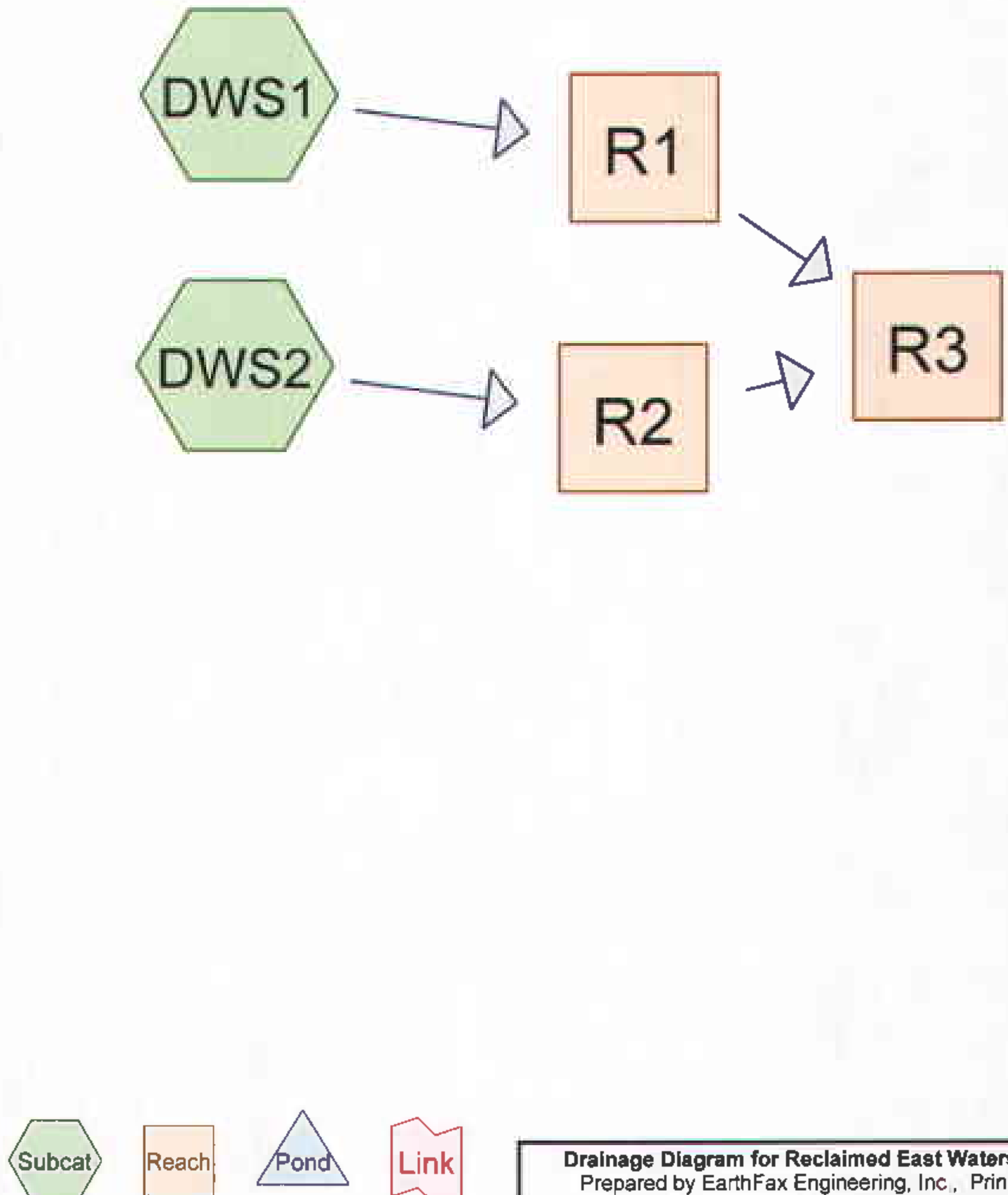


FIGURE 5-2 Size of Stone that will Resist Displacement for Various Velocities and Side Slopes (U.S. Department of Transportation, 1978).



Drainage Diagram for Reclaimed East Watersheds 10yr, 24hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DWS1: Runoff Area=14.800 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=1,680' Slope=0.5090 '/' Tc=9.8 min CN=67 Runoff=0.59 cfs 0.127 af

Subcatchment DWS2: Runoff Area=37.100 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=1,490' Slope=0.5770 '/' Tc=8.3 min CN=67 Runoff=1.65 cfs 0.318 af

Reach R1: Avg. Depth=0.21' Max Vel=3.92 fps Inflow=0.59 cfs 0.127 af
n=0.022 L=820.0' S=0.0732 '/' Capacity=15.48 cfs Outflow=0.51 cfs 0.127 af

Reach R2: Avg. Depth=0.32' Max Vel=4.05 fps Inflow=1.65 cfs 0.318 af
n=0.022 L=1,320.0' S=0.0455 '/' Capacity=17.04 cfs Outflow=1.20 cfs 0.318 af

Reach R3: Avg. Depth=0.36' Max Vel=4.27 fps Inflow=1.68 cfs 0.445 af
n=0.022 L=560.0' S=0.0429 '/' Capacity=19.27 cfs Outflow=1.64 cfs 0.445 af

Total Runoff Area = 51.900 ac Runoff Volume = 0.445 af Average Runoff Depth = 0.10"
100.00% Pervious = 51.900 ac 0.00% Impervious = 0.000 ac

Summary for Reach R1:

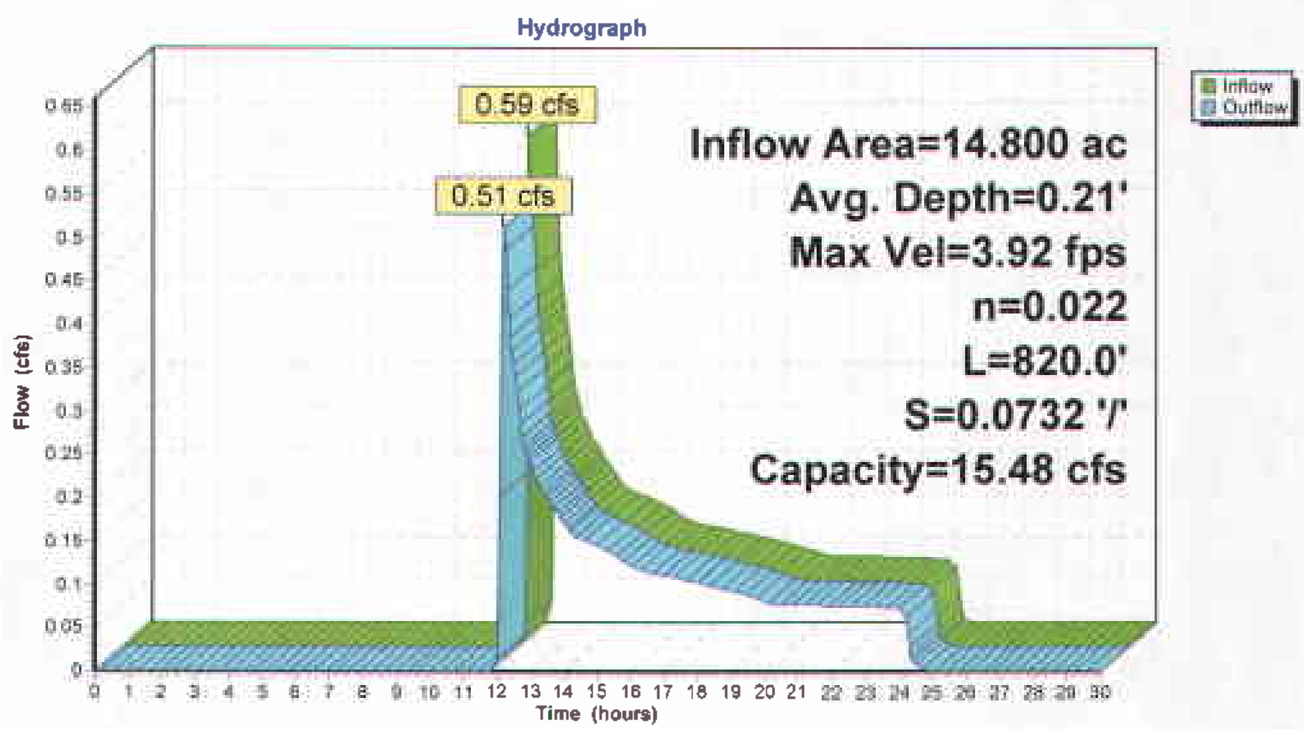
Inflow Area = 14.800 ac, 0.00% Impervious, Inflow Depth = 0.10"
Inflow = 0.59 cfs @ 12.10 hrs, Volume= 0.127 af
Outflow = 0.51 cfs @ 12.22 hrs, Volume= 0.127 af, Atten= 13%, Lag= 7.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.92 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 2.48 fps, Avg. Travel Time= 5.5 min

Peak Storage= 108 cf @ 12.16 hrs, Average Depth at Peak Storage= 0.21'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 15.48 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 4.50'
Length= 820.0' Slope= 0.0732 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,680.00'

Reach R1:



Summary for Reach R2:

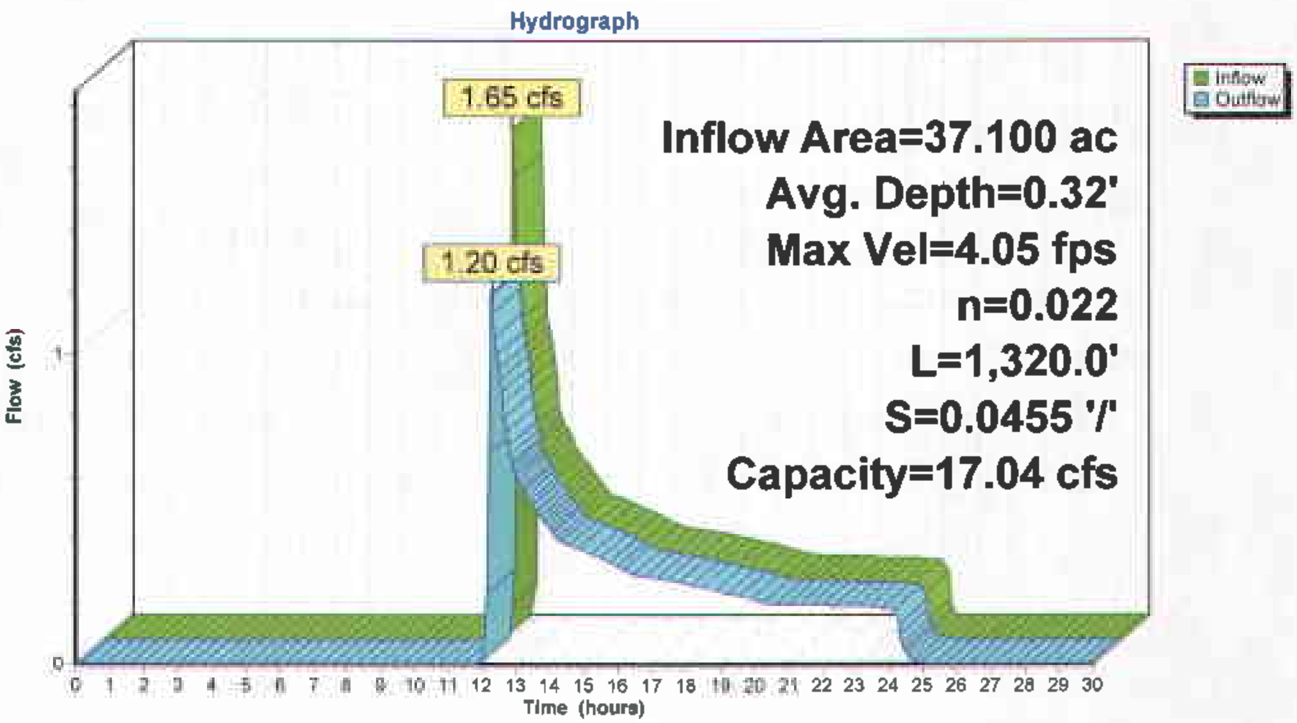
Inflow Area = 37.100 ac, 0.00% Impervious, Inflow Depth = 0.10"
Inflow = 1.65 cfs @ 12.07 hrs, Volume= 0.318 af
Outflow = 1.20 cfs @ 12.26 hrs, Volume= 0.318 af, Atten= 27%, Lag= 11.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.05 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 2.38 fps, Avg. Travel Time= 9.2 min

Peak Storage= 394 cf @ 12.16 hrs, Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 0.85', Capacity at Bank-Full= 17.04 cfs

0.00' x 0.85' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 5.10'
Length= 1,320.0' Slope= 0.0455 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,680.00'

Reach R2:



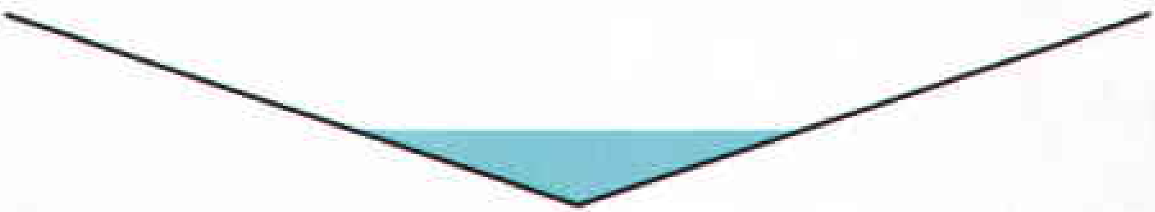
Summary for Reach R3:

Inflow Area = 51.900 ac, 0.00% Impervious, Inflow Depth = 0.10"
Inflow = 1.68 cfs @ 12.25 hrs, Volume= 0.445 af
Outflow = 1.64 cfs @ 12.32 hrs, Volume= 0.445 af, Atten= 2%, Lag= 4.5 min

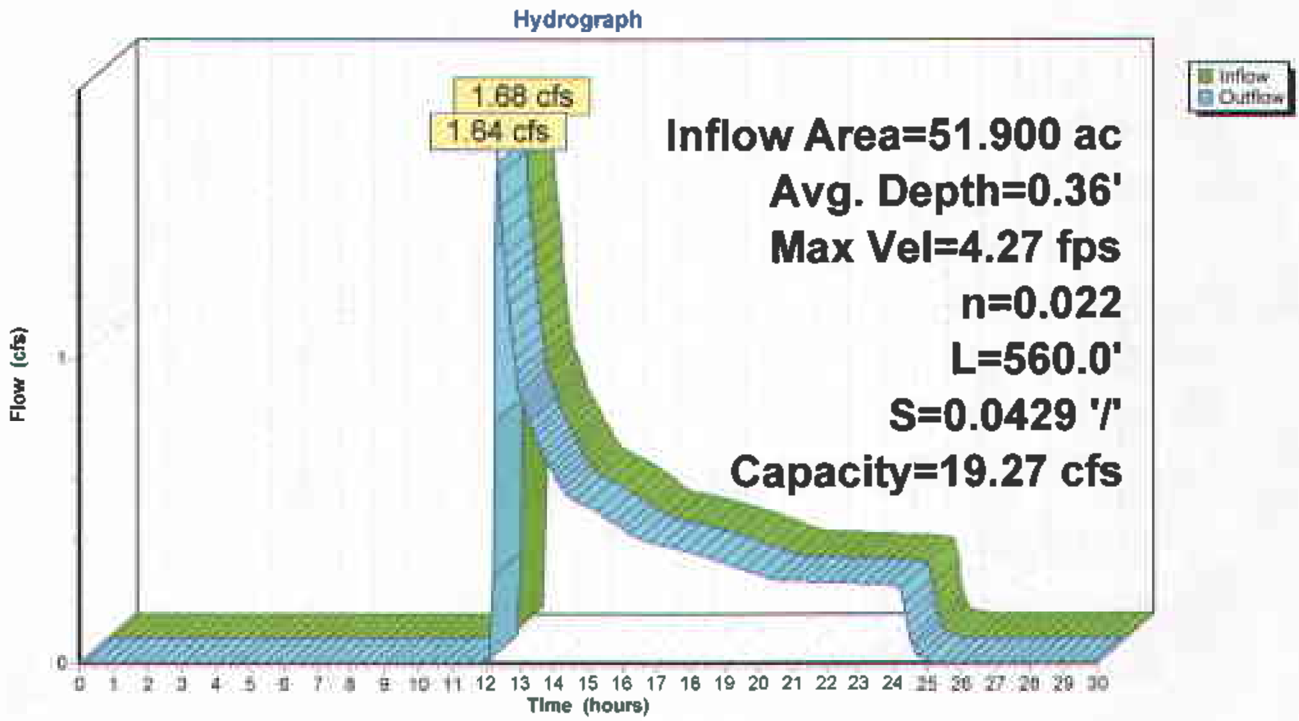
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.27 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 2.46 fps, Avg. Travel Time= 3.8 min

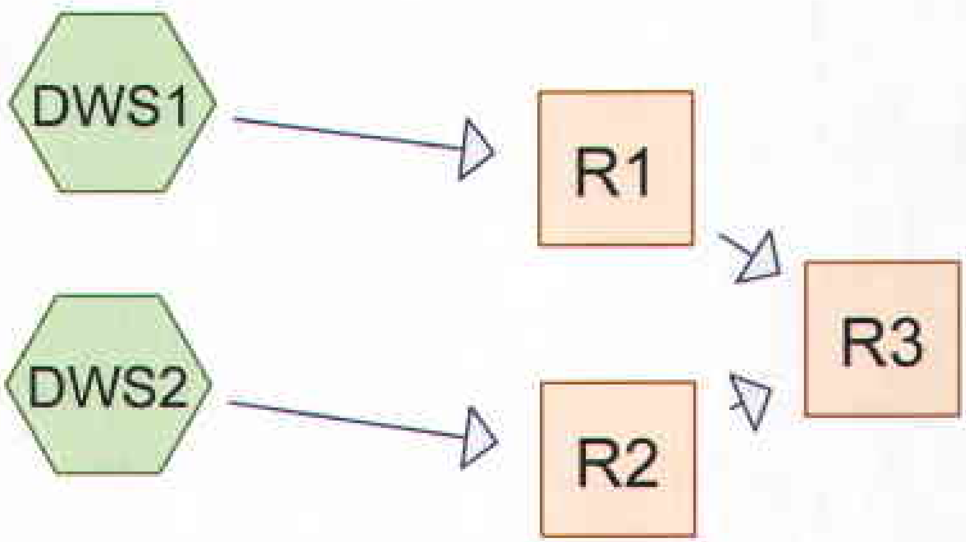
Peak Storage= 214 cf @ 12.28 hrs, Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 0.90', Capacity at Bank-Full= 19.27 cfs

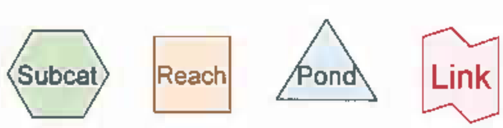
0.00' x 0.90' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 5.40'
Length= 560.0' Slope= 0.0429 '/'
Inlet Invert= 5,679.00', Outlet Invert= 5,655.00'



Reach R3:







Drainage Diagram for Reclaimed East Watersheds 100yr, 0.5hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009

Time span=0.00-5.00 hrs, dt=0.05 hrs, 101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DWS1: Runoff Area=14.800 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=1,680' Slope=0.5090 '/' Tc=9.8 min CN=67 Runoff=0.75 cfs 0.014 af

Subcatchment DWS2: Runoff Area=37.100 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=1,490' Slope=0.5770 '/' Tc=8.3 min CN=67 Runoff=1.99 cfs 0.036 af

Reach R1: Avg. Depth=0.23' Max Vel=4.19 fps Inflow=0.75 cfs 0.014 af
n=0.022 L=820.0' S=0.0732 '/' Capacity=15.48 cfs Outflow=0.68 cfs 0.014 af

Reach R2: Avg. Depth=0.35' Max Vel=4.36 fps Inflow=1.99 cfs 0.036 af
n=0.022 L=1,320.0' S=0.0455 '/' Capacity=17.04 cfs Outflow=1.60 cfs 0.036 af

Reach R3: Avg. Depth=0.40' Max Vel=4.58 fps Inflow=2.26 cfs 0.050 af
n=0.022 L=560.0' S=0.0429 '/' Capacity=19.27 cfs Outflow=2.12 cfs 0.050 af

Total Runoff Area = 51.900 ac Runoff Volume = 0.050 af Average Runoff Depth = 0.01"
100.00% Pervious = 51.900 ac 0.00% Impervious = 0.000 ac

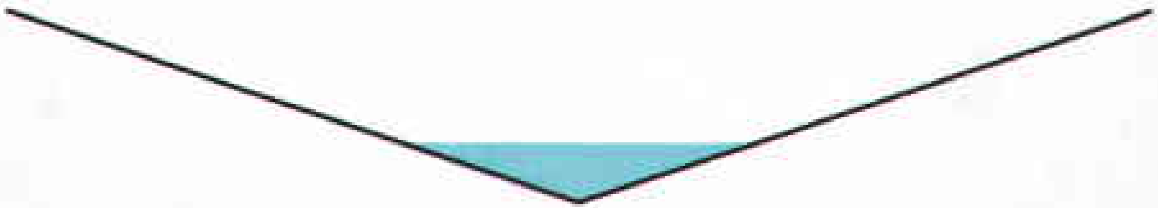
Summary for Reach R1:

Inflow Area = 14.800 ac, 0.00% Impervious, Inflow Depth = 0.01"
Inflow = 0.75 cfs @ 0.54 hrs, Volume= 0.014 af
Outflow = 0.68 cfs @ 0.64 hrs, Volume= 0.014 af, Atten= 10%, Lag= 5.7 min

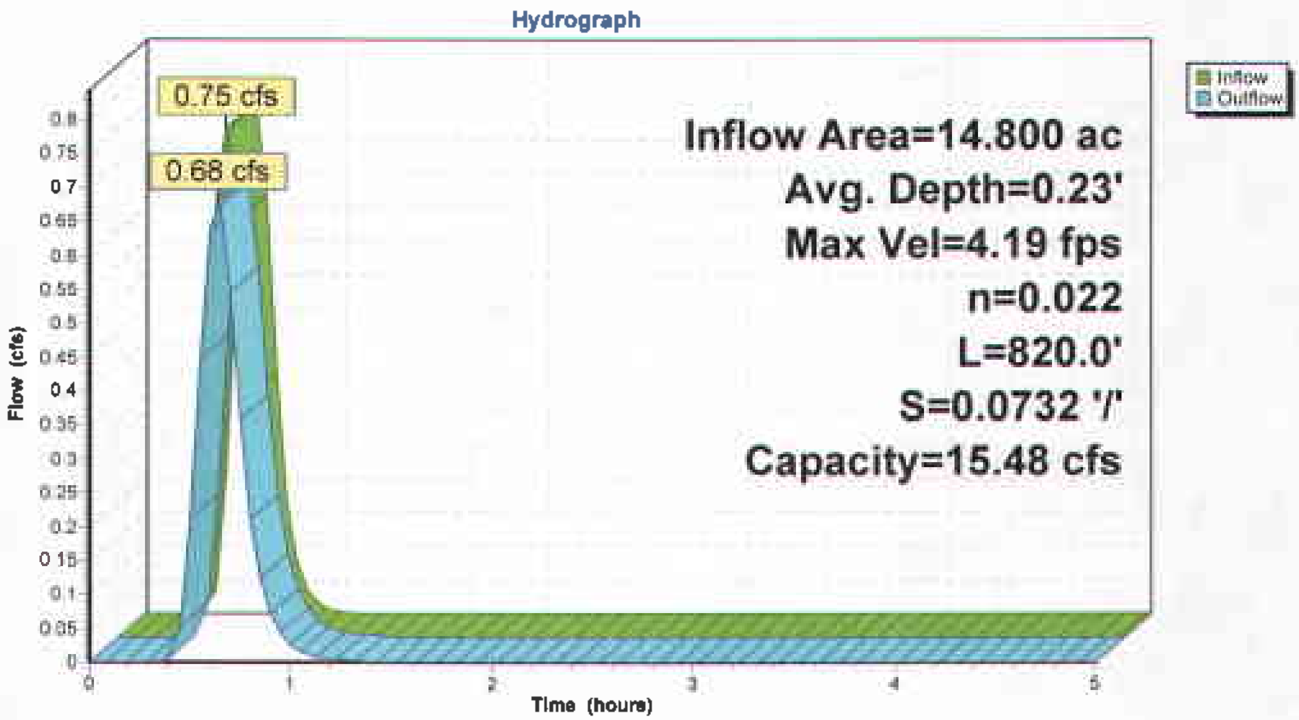
Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.19 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 1.43 fps, Avg. Travel Time= 9.6 min

Peak Storage= 134 cf @ 0.58 hrs, Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 15.48 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 4.50'
Length= 820.0' Slope= 0.0732 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,680.00'



Reach R1:



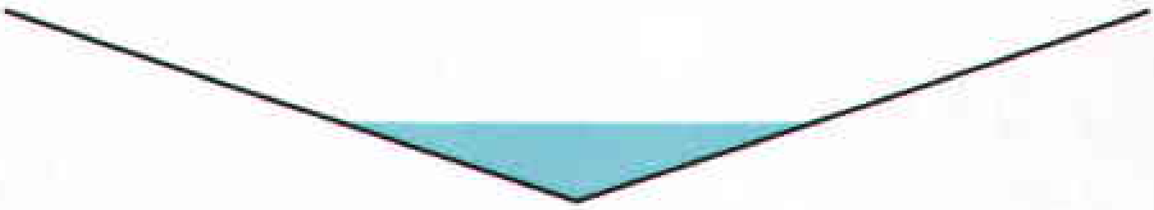
Summary for Reach R2:

Inflow Area = 37.100 ac, 0.00% Impervious, Inflow Depth = 0.01"
Inflow = 1.99 cfs @ 0.53 hrs, Volume= 0.036 af
Outflow = 1.60 cfs @ 0.66 hrs, Volume= 0.036 af, Atten= 20%, Lag= 8.2 min

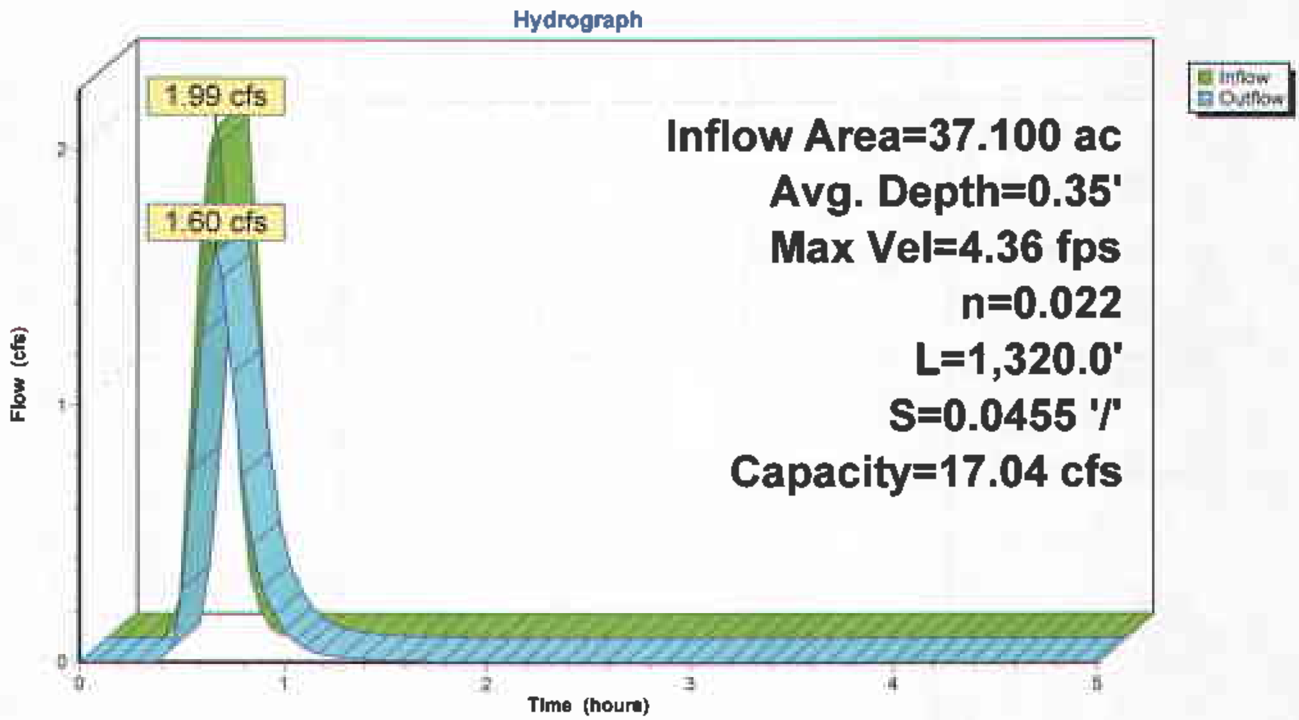
Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.36 fps, Min. Travel Time= 5.0 min
Avg. Velocity = 1.10 fps, Avg. Travel Time= 20.1 min

Peak Storage= 494 cf @ 0.58 hrs, Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 0.85', Capacity at Bank-Full= 17.04 cfs

0.00' x 0.85' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 5.10'
Length= 1,320.0' Slope= 0.0455 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,680.00'



Reach R2:



Summary for Reach R3:

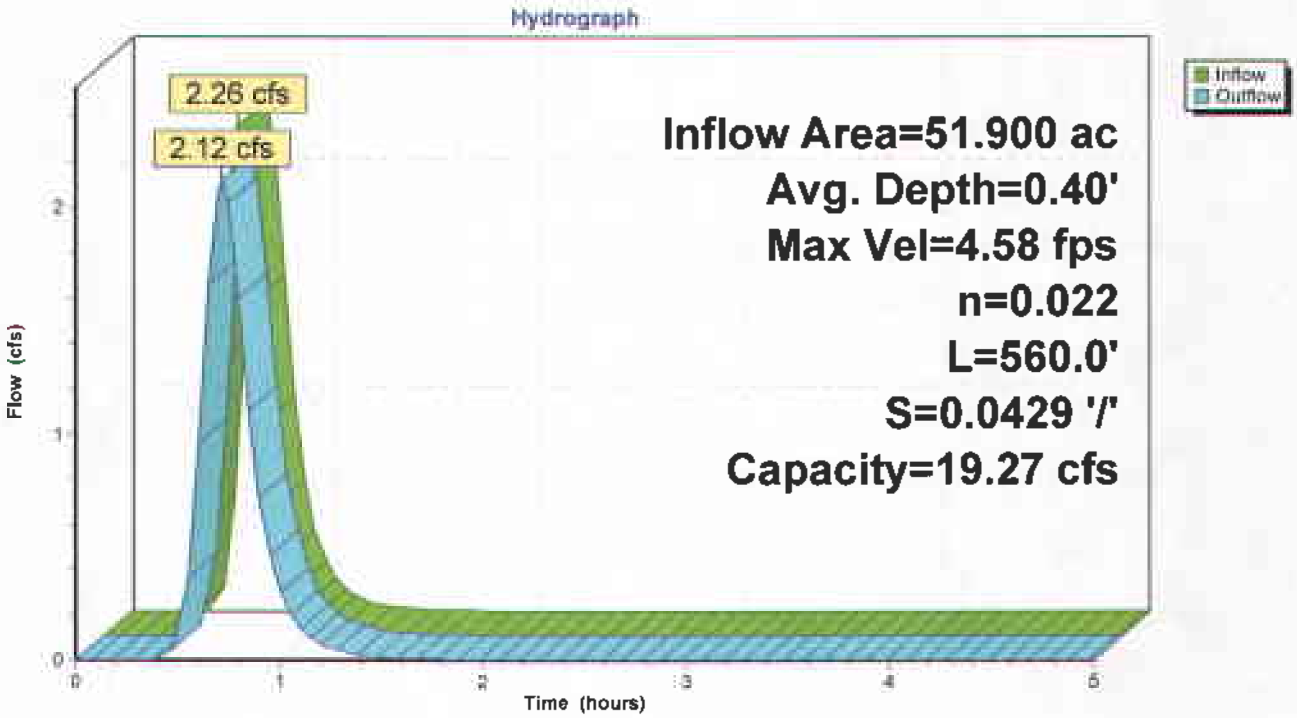
Inflow Area = 51.900 ac, 0.00% Impervious, Inflow Depth = 0.01"
Inflow = 2.26 cfs @ 0.66 hrs, Volume= 0.050 af
Outflow = 2.12 cfs @ 0.72 hrs, Volume= 0.050 af, Atten= 6%, Lag= 3.8 min

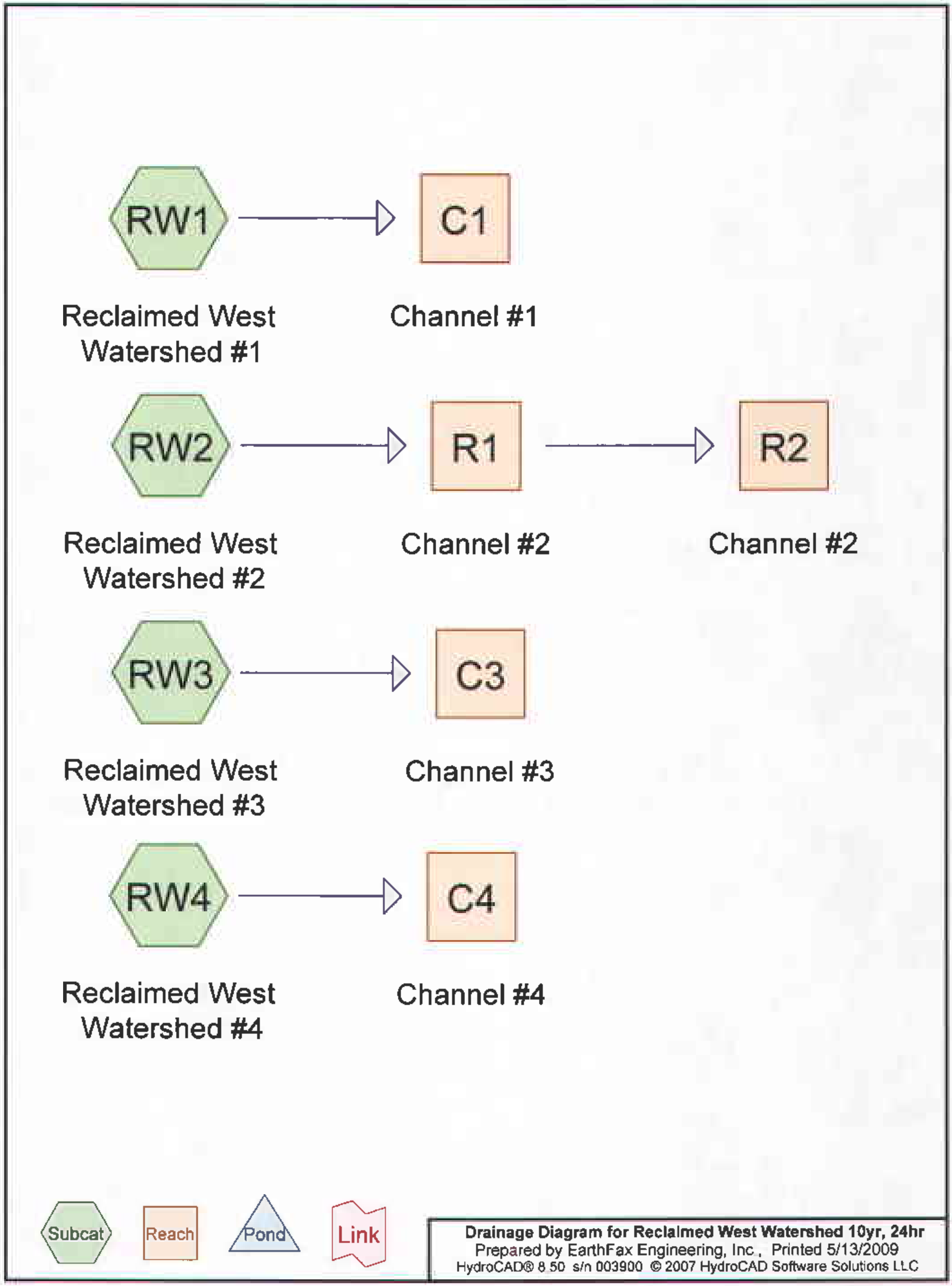
Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.58 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.09 fps, Avg. Travel Time= 8.5 min

Peak Storage= 265 cf @ 0.68 hrs, Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 0.90', Capacity at Bank-Full= 19.27 cfs

0.00' x 0.90' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 5.40'
Length= 560.0' Slope= 0.0429 '/'
Inlet Invert= 5,679.00', Outlet Invert= 5,655.00'

Reach R3:




RW1
C1
Reclaimed West Watershed #1
Channel #1
RW2
R1
R2
Reclaimed West Watershed #2
Channel #2
Channel #2
RW3
C3
Reclaimed West Watershed #3
Channel #3
RW4
C4
Reclaimed West Watershed #4
Channel #4
Subcat
Reach
Pond
Link
Drainage Diagram for Reclaimed West Watershed 10yr, 24hr
Prepared by EarthFax Engineering, Inc., Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment RW1: Reclaimed West Runoff Area=42.200 ac 0.00% Impervious Runoff Depth=0.09"
Flow Length=2,084' Slope=0.3480 '/' Tc=14.0 min CN=67 Runoff=1.08 cfs 0.327 af

Subcatchment RW2: Reclaimed West Runoff Area=96.200 ac 0.00% Impervious Runoff Depth=0.09"
Flow Length=4,128' Slope=0.3520 '/' Tc=24.1 min CN=67 Runoff=2.02 cfs 0.746 af

Subcatchment RW3: Reclaimed West Runoff Area=8.200 ac 0.00% Impervious Runoff Depth=0.09"
Flow Length=957' Slope=0.3240 '/' Tc=7.8 min CN=67 Runoff=0.29 cfs 0.064 af

Subcatchment RW4: Reclaimed West Runoff Area=13.800 ac 0.00% Impervious Runoff Depth=0.09"
Flow Length=2,631' Slope=0.3460 '/' Tc=16.9 min CN=67 Runoff=0.33 cfs 0.107 af

Reach C1: Channel #1 Avg. Depth=0.26' Max Vel=7.60 fps Inflow=1.08 cfs 0.327 af
n=0.022 L=1,680.0' S=0.2262 '/' Capacity=17.45 cfs Outflow=1.01 cfs 0.327 af

Reach C3: Channel #3 Avg. Depth=0.19' Max Vel=3.59 fps Inflow=0.29 cfs 0.064 af
n=0.040 L=480.0' S=0.2500 '/' Capacity=8.39 cfs Outflow=0.26 cfs 0.064 af

Reach C4: Channel #4 Avg. Depth=0.19' Max Vel=4.09 fps Inflow=0.33 cfs 0.107 af
n=0.040 L=1,137.0' S=0.3166 '/' Capacity=9.44 cfs Outflow=0.31 cfs 0.107 af

Reach R1: Channel #2 Avg. Depth=0.44' Max Vel=5.15 fps Inflow=2.02 cfs 0.746 af
n=0.040 L=894.0' S=0.1672 '/' Capacity=17.77 cfs Outflow=2.01 cfs 0.746 af

Reach R2: Channel #2 Avg. Depth=0.51' Max Vel=3.79 fps Inflow=2.01 cfs 0.746 af
n=0.040 L=800.0' S=0.0744 '/' Capacity=11.85 cfs Outflow=1.99 cfs 0.746 af

Total Runoff Area = 160.400 ac Runoff Volume = 1.243 af Average Runoff Depth = 0.09"
100.00% Pervious = 160.400 ac 0.00% Impervious = 0.000 ac

Summary for Reach C1: Channel #1

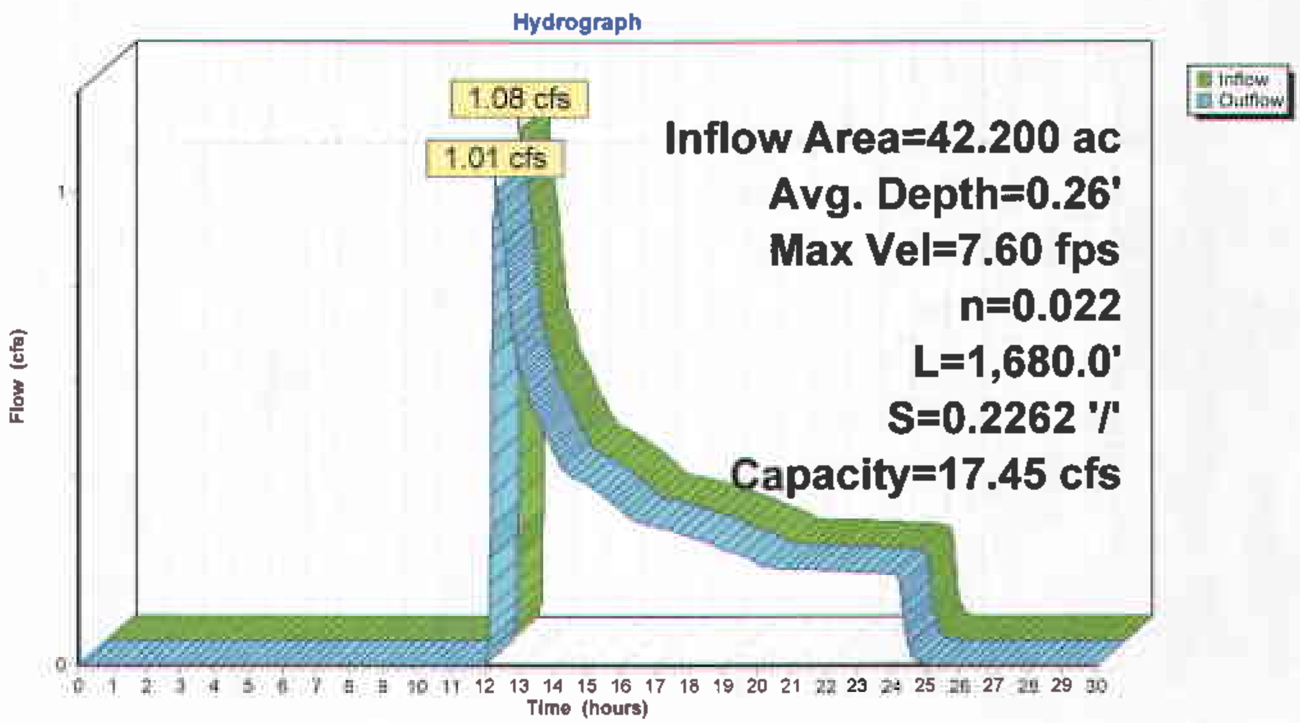
Inflow Area = 42.200 ac, 0.00% Impervious, Inflow Depth = 0.09"
Inflow = 1.08 cfs @ 12.18 hrs, Volume= 0.327 af
Outflow = 1.01 cfs @ 12.30 hrs, Volume= 0.327 af, Atten= 7%, Lag= 7.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.60 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 5.10 fps, Avg. Travel Time= 5.5 min

Peak Storage= 222 cf @ 12.24 hrs, Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 17.45 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 1,680.0' Slope= 0.2262 '/'
Inlet Invert= 6,800.00', Outlet Invert= 6,420.00'

Reach C1: Channel #1



Summary for Reach C3: Channel #3

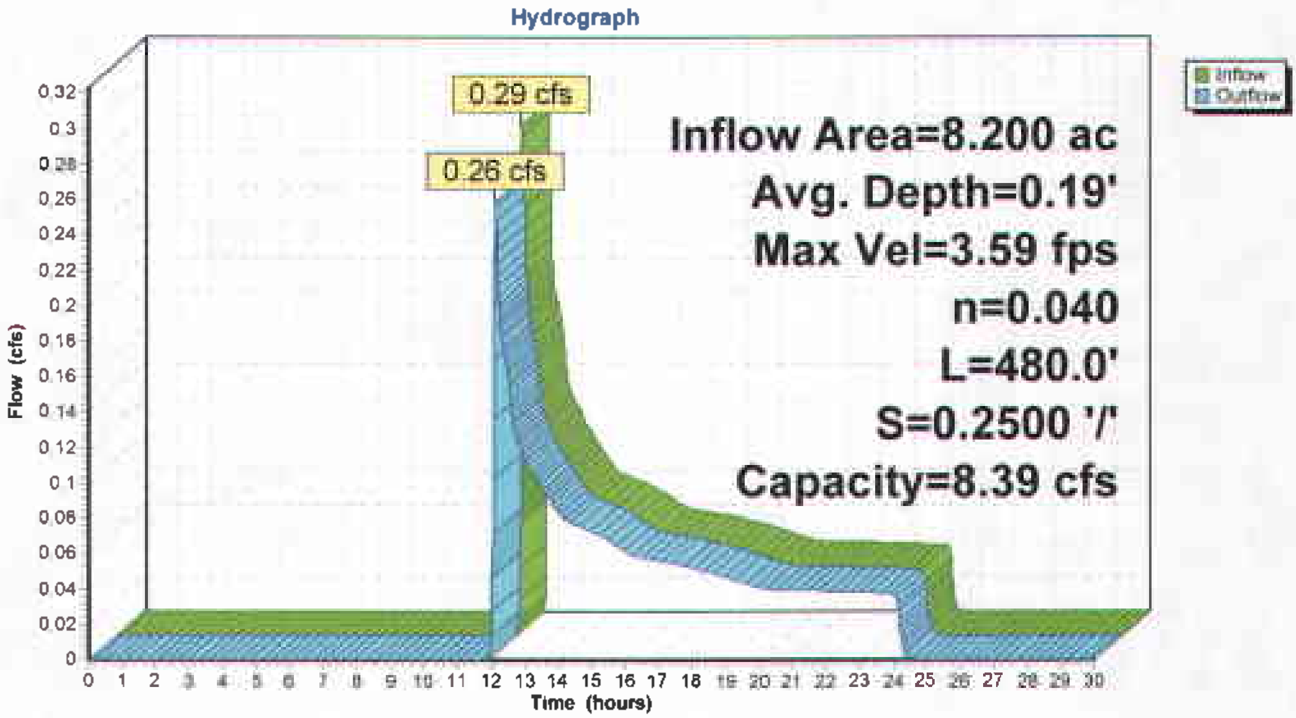
Inflow Area = 8.200 ac, 0.00% Impervious, Inflow Depth = 0.09"
Inflow = 0.29 cfs @ 12.06 hrs, Volume= 0.064 af
Outflow = 0.26 cfs @ 12.13 hrs, Volume= 0.064 af, Atten= 10%, Lag= 4.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.59 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 2.37 fps, Avg. Travel Time= 3.4 min

Peak Storage= 35 cf @ 12.10 hrs, Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 0.70', Capacity at Bank-Full= 8.39 cfs

0.00' x 0.70' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 2.80'
Length= 480.0' Slope= 0.2500 '/'
Inlet Invert= 5,650.00', Outlet Invert= 5,530.00'

Reach C3: Channel #3



Summary for Reach C4: Channel #4

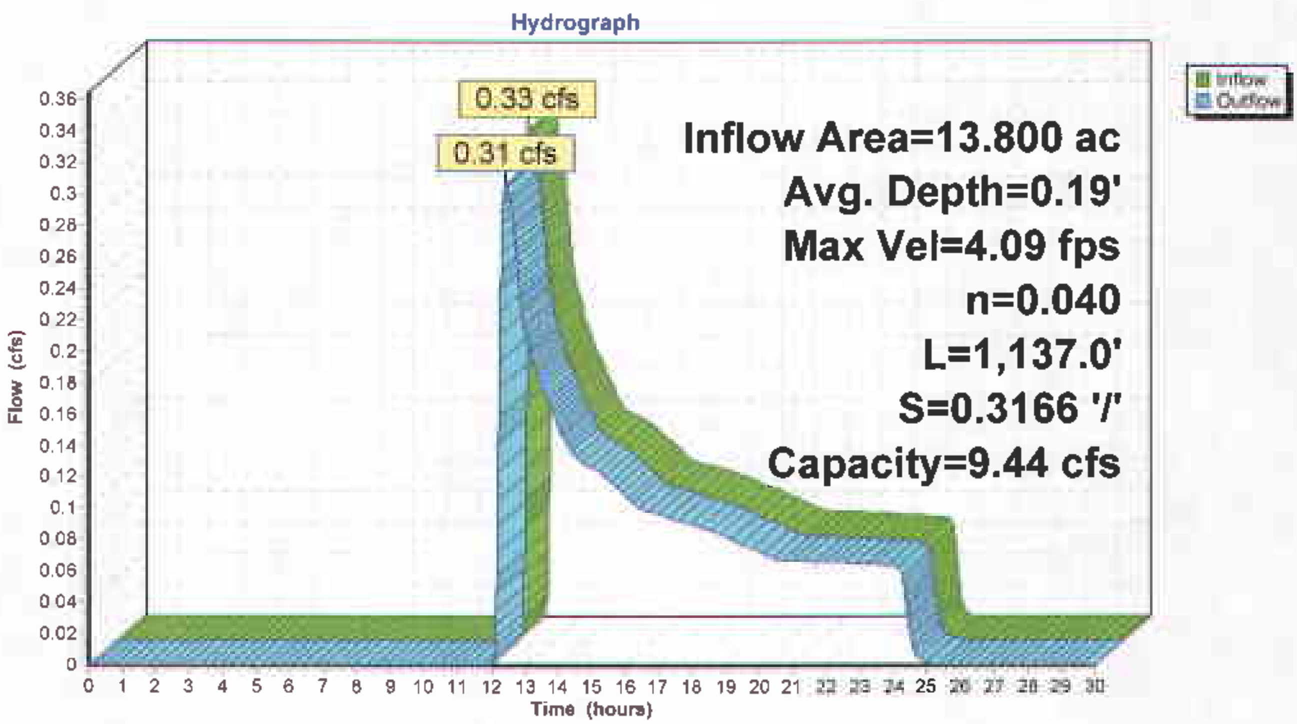
Inflow Area = 13.800 ac, 0.00% Impervious, Inflow Depth = 0.09"
Inflow = 0.33 cfs @ 12.23 hrs, Volume= 0.107 af
Outflow = 0.31 cfs @ 12.42 hrs, Volume= 0.107 af, Atten= 6%, Lag= 11.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.09 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 2.80 fps, Avg. Travel Time= 6.8 min

Peak Storage= 85 cf @ 12.34 hrs, Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 0.70', Capacity at Bank-Full= 9.44 cfs

0.00' x 0.70' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 2.80'
Length= 1,137.0' Slope= 0.3166 '/'
Inlet Invert= 5,860.00', Outlet Invert= 5,500.00'

Reach C4: Channel #4



Summary for Reach R1: Channel #2

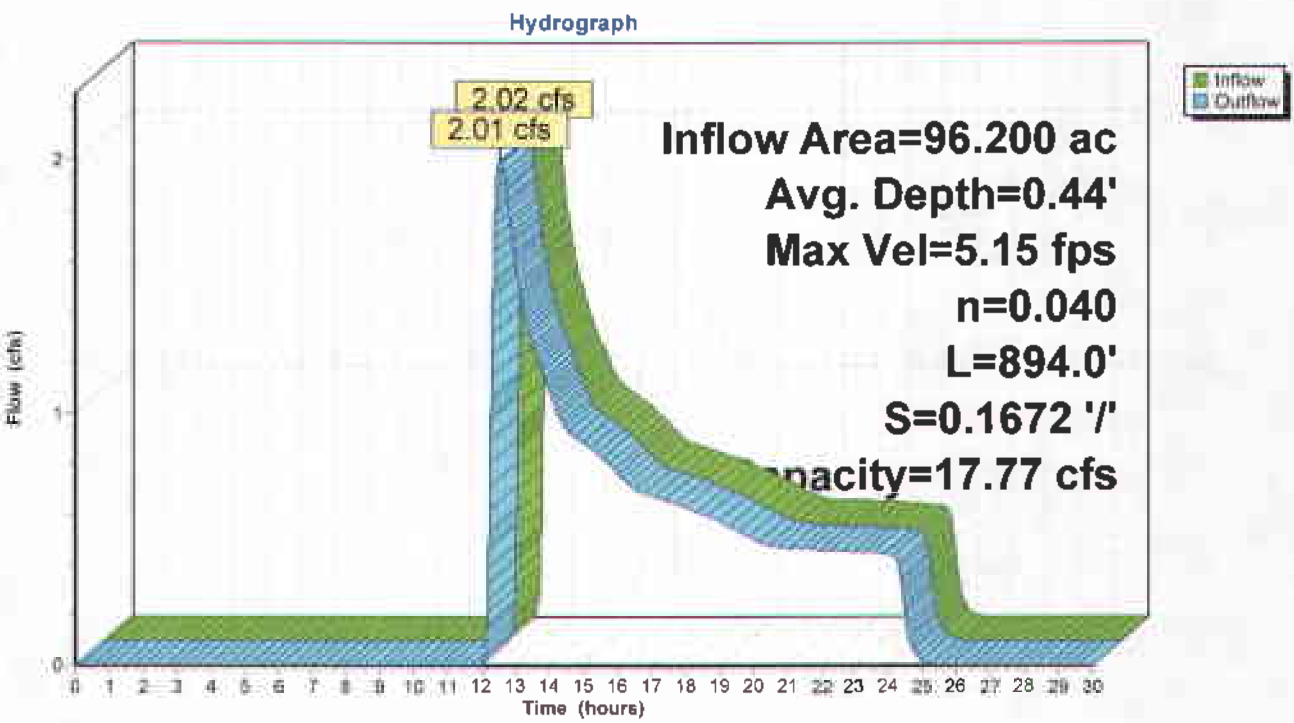
Inflow Area =	96.200 ac,	0.00% Impervious,	Inflow Depth =	0.09"	
Inflow =	2.02 cfs @	12.40 hrs,	Volume=	0.746 af	
Outflow =	2.01 cfs @	12.51 hrs,	Volume=	0.746 af,	Atten= 1%, Lag= 6.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.15 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 3.45 fps, Avg. Travel Time= 4.3 min

Peak Storage= 348 cf @ 12.46 hrs, Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 17.77 cfs

0.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 894.0' Slope= 0.1672 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,590.50'

Reach R1: Channel #2



Summary for Reach R2: Channel #2

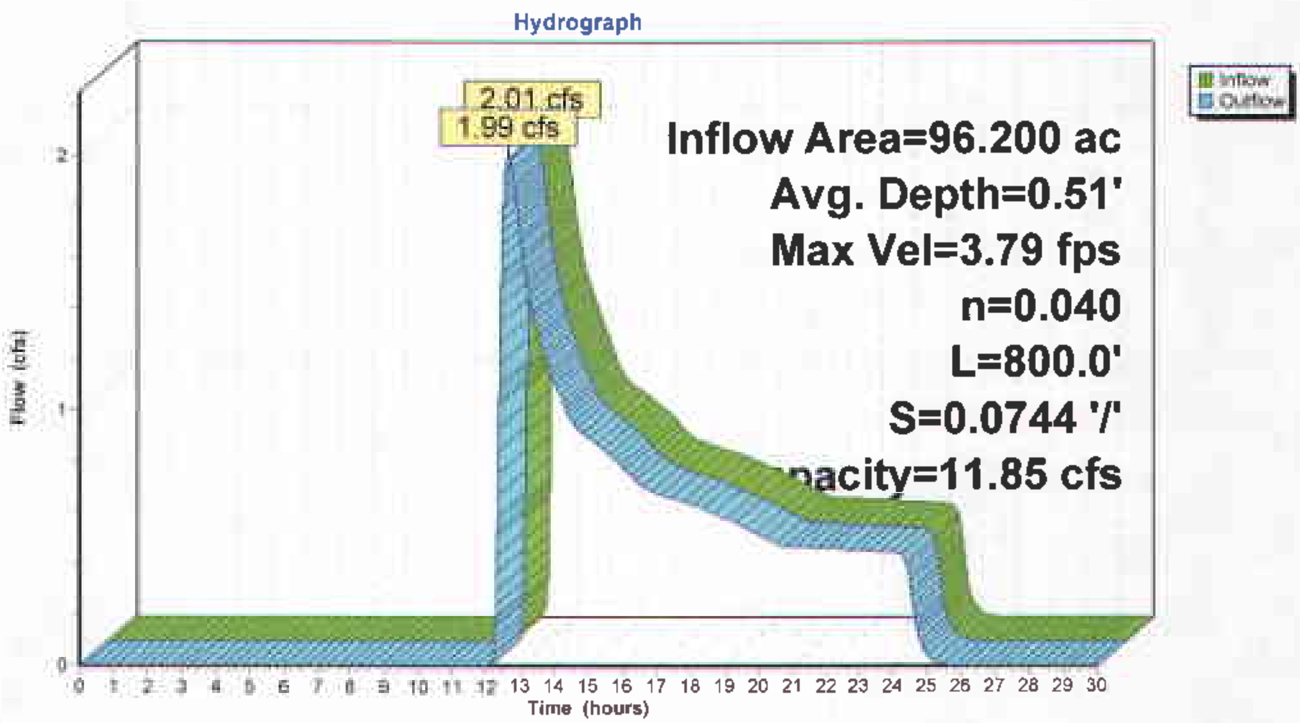
Inflow Area = 96.200 ac, 0.00% Impervious, Inflow Depth = 0.09"
Inflow = 2.01 cfs @ 12.51 hrs, Volume= 0.746 af
Outflow = 1.99 cfs @ 12.64 hrs, Volume= 0.746 af, Atten= 1%, Lag= 8.1 min

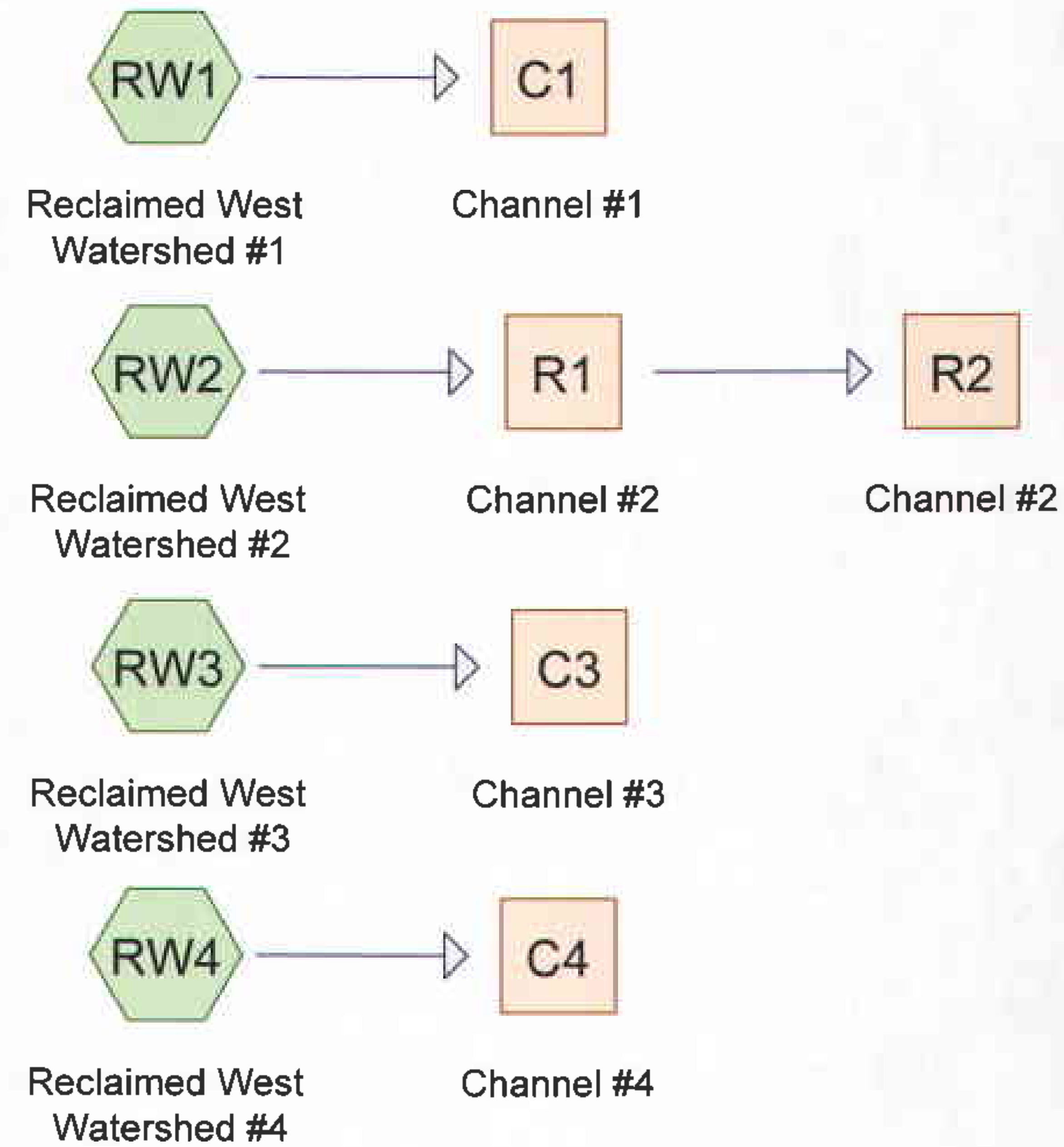
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.79 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 2.38 fps, Avg. Travel Time= 5.6 min

Peak Storage= 420 cf @ 12.58 hrs, Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 11.85 cfs

0.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 800.0' Slope= 0.0744 '/'
Inlet Invert= 5,589.50', Outlet Invert= 5,530.00'

Reach R2: Channel #2





Drainage Diagram for Reclaimed West Watershed 100yr, 0.5hr
Prepared by EarthFax Engineering, Inc , Printed 5/13/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Time span=0.00-5.00 hrs, dt=0.01 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment RW1: Reclaimed West Runoff Area=42.200 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=2,084' Slope=0.3480 '/' Tc=14.0 min CN=67 Runoff=1.85 cfs 0.041 af

Subcatchment RW2: Reclaimed West Runoff Area=96.200 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=4,128' Slope=0.3520 '/' Tc=24.1 min CN=67 Runoff=2.86 cfs 0.093 af

Subcatchment RW3: Reclaimed West Runoff Area=8.200 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=957' Slope=0.3240 '/' Tc=7.8 min CN=67 Runoff=0.45 cfs 0.008 af

Subcatchment RW4: Reclaimed West Runoff Area=13.800 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=2,631' Slope=0.3460 '/' Tc=16.9 min CN=67 Runoff=0.54 cfs 0.013 af

Reach C1: Channel #1 Avg. Depth=0.31' Max Vel=8.69 fps Inflow=1.85 cfs 0.041 af
n=0.022 L=1,680.0' S=0.2262 '/' Capacity=17.45 cfs Outflow=1.71 cfs 0.041 af

Reach C3: Channel #3 Avg. Depth=0.23' Max Vel=4.09 fps Inflow=0.45 cfs 0.008 af
n=0.040 L=480.0' S=0.2500 '/' Capacity=64.05 cfs Outflow=0.44 cfs 0.008 af

Reach C4: Channel #4 Avg. Depth=0.23' Max Vel=4.59 fps Inflow=0.54 cfs 0.013 af
n=0.040 L=1,137.0' S=0.3166 '/' Capacity=72.09 cfs Outflow=0.49 cfs 0.013 af

Reach R1: Channel #2 Avg. Depth=0.50' Max Vel=5.59 fps Inflow=2.86 cfs 0.093 af
n=0.040 L=894.0' S=0.1672 '/' Capacity=52.39 cfs Outflow=2.78 cfs 0.093 af

Reach R2: Channel #2 Avg. Depth=0.57' Max Vel=4.08 fps Inflow=2.78 cfs 0.093 af
n=0.040 L=800.0' S=0.0744 '/' Capacity=34.94 cfs Outflow=2.66 cfs 0.093 af

Total Runoff Area = 160.400 ac Runoff Volume = 0.155 af Average Runoff Depth = 0.01"
100.00% Pervious = 160.400 ac 0.00% Impervious = 0.000 ac

Summary for Reach C1: Channel #1

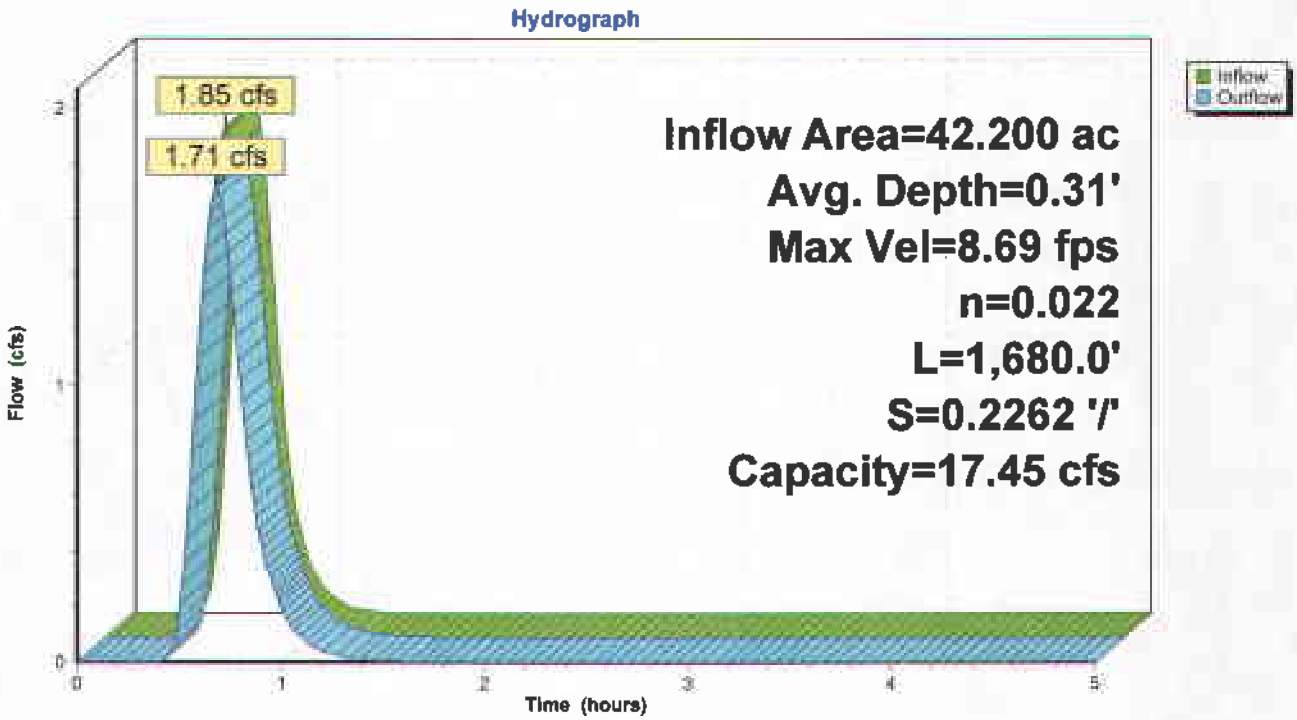
Inflow Area = 42.200 ac, 0.00% Impervious, Inflow Depth = 0.01"
Inflow = 1.85 cfs @ 0.59 hrs, Volume= 0.041 af
Outflow = 1.71 cfs @ 0.68 hrs, Volume= 0.041 af, Atten= 7%, Lag= 5.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.69 fps, Min. Travel Time= 3.2 min
Avg. Velocity = 2.95 fps, Avg. Travel Time= 9.5 min

Peak Storage= 332 cf @ 0.63 hrs, Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 0.75', Capacity at Bank-Full= 17.45 cfs

0.00' x 0.75' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 3.00'
Length= 1,680.0' Slope= 0.2262 '/'
Inlet Invert= 6,800.00', Outlet Invert= 6,420.00'

Reach C1: Channel #1



Summary for Reach C3: Channel #3

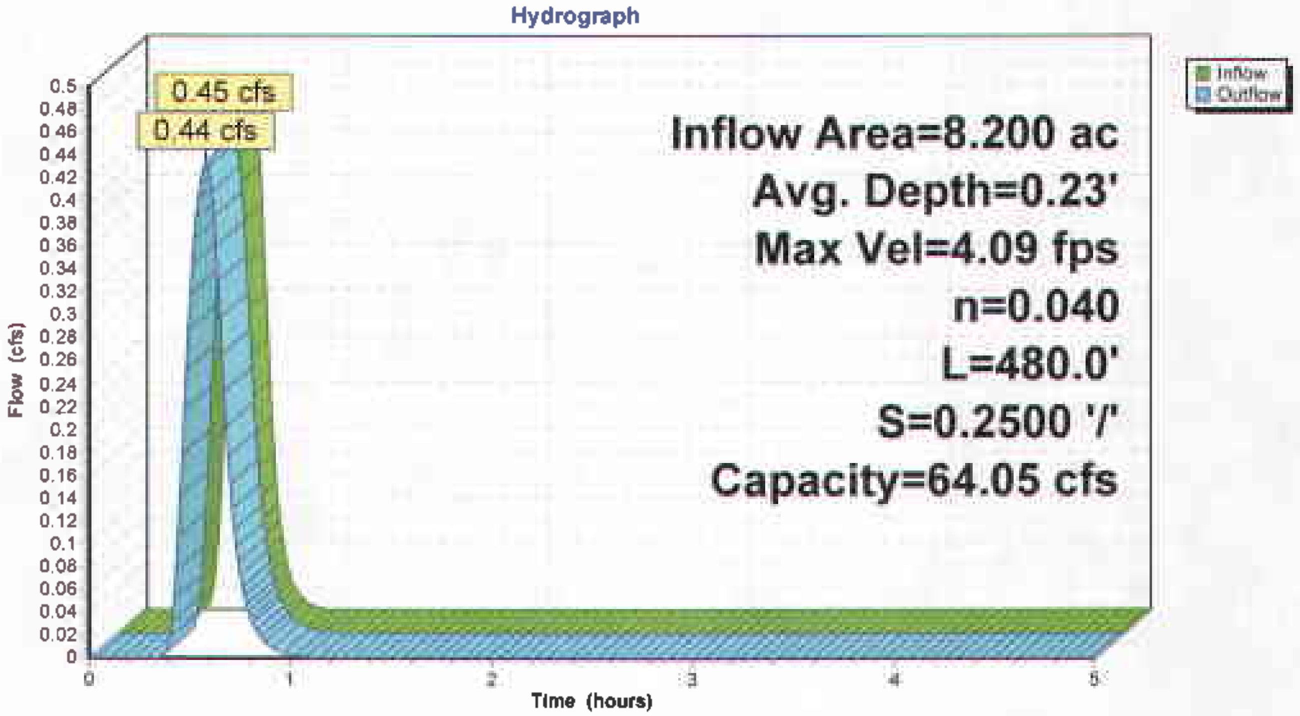
Inflow Area = 8.200 ac, 0.00% Impervious, Inflow Depth = 0.01"
Inflow = 0.45 cfs @ 0.53 hrs, Volume= 0.008 af
Outflow = 0.44 cfs @ 0.58 hrs, Volume= 0.008 af, Atten= 3%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.09 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.78 fps, Avg. Travel Time= 4.5 min

Peak Storage= 51 cf @ 0.55 hrs, Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 64.05 cfs

0.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 480.0' Slope= 0.2500 '/'
Inlet Invert= 5,650.00', Outlet Invert= 5,530.00'

Reach C3: Channel #3



Summary for Reach C4: Channel #4

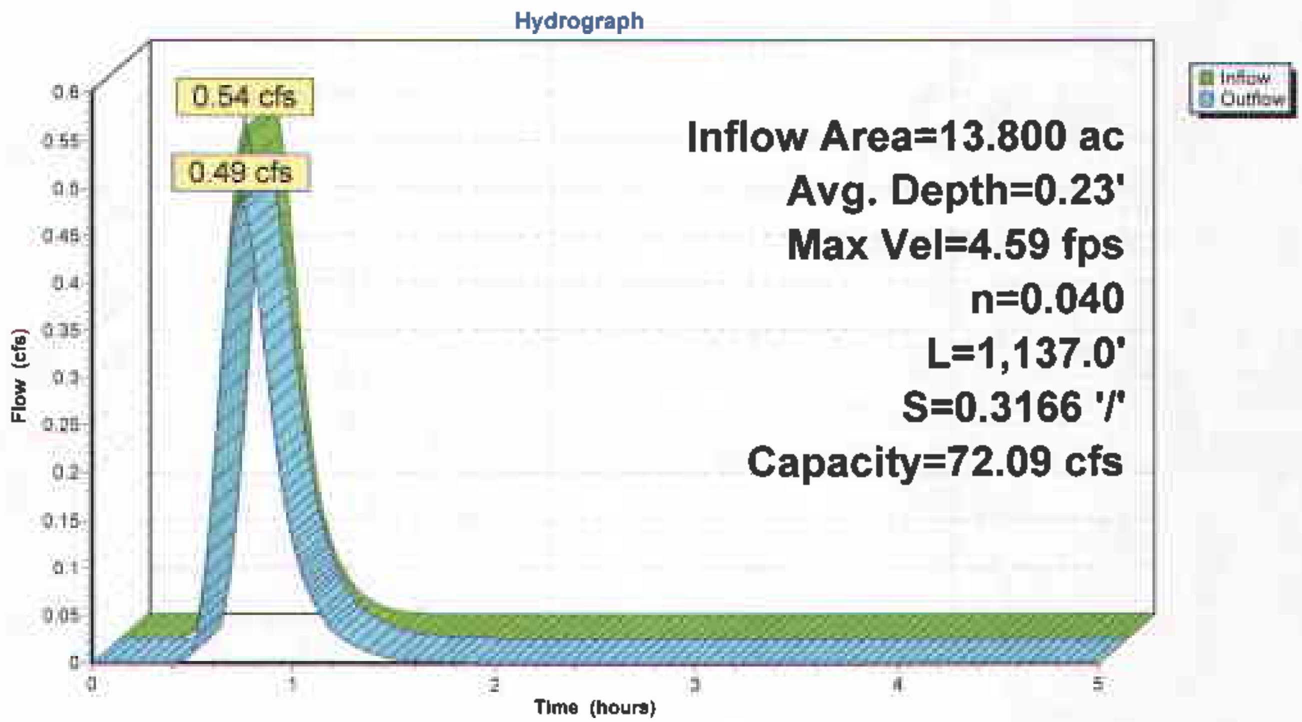
Inflow Area = 13.800 ac, 0.00% Impervious, Inflow Depth = 0.01"
Inflow = 0.54 cfs @ 0.62 hrs, Volume= 0.013 af
Outflow = 0.49 cfs @ 0.74 hrs, Volume= 0.013 af, Atten= 10%, Lag= 7.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.59 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 1.84 fps, Avg. Travel Time= 10.3 min

Peak Storage= 120 cf @ 0.67 hrs, Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 72.09 cfs

0.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 1,137.0' Slope= 0.3166 '/'
Inlet Invert= 5,860.00', Outlet Invert= 5,500.00'

Reach C4: Channel #4



Summary for Reach R1: Channel #2

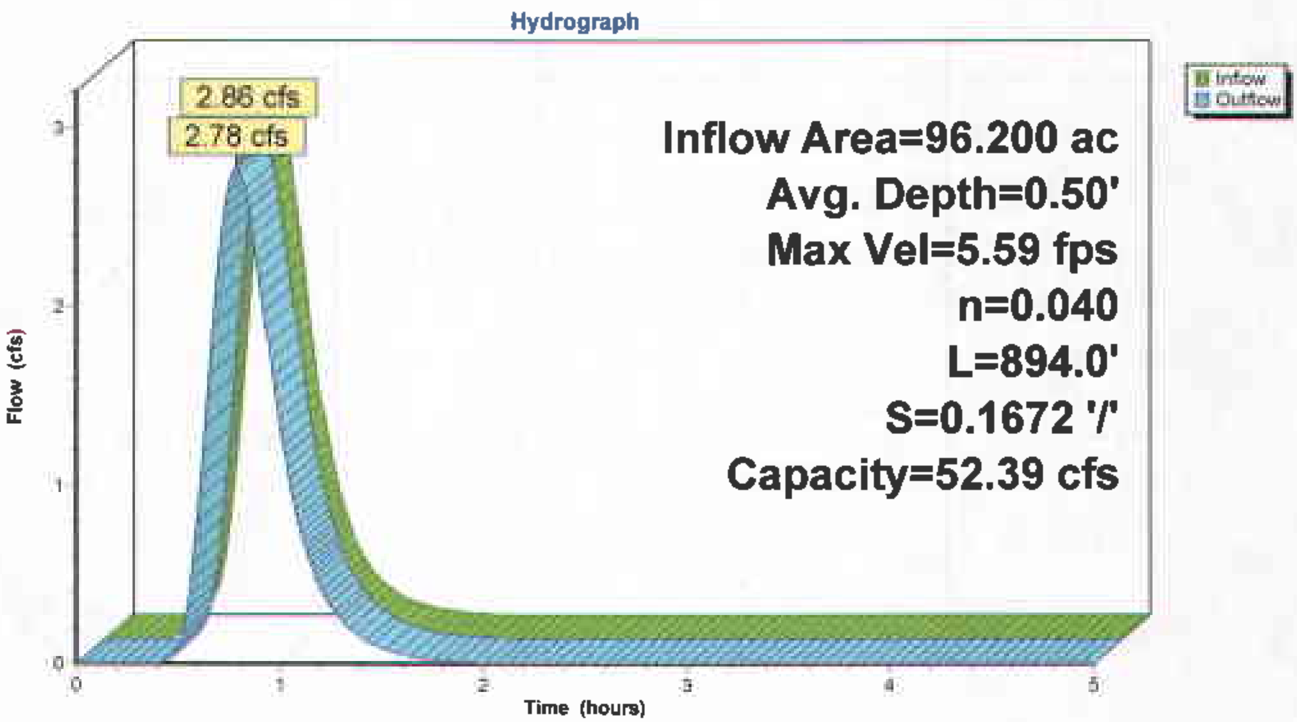
Inflow Area = 96.200 ac, 0.00% Impervious, Inflow Depth = 0.01"
Inflow = 2.86 cfs @ 0.70 hrs, Volume= 0.093 af
Outflow = 2.78 cfs @ 0.78 hrs, Volume= 0.093 af, Atten= 3%, Lag= 4.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.59 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 2.01 fps, Avg. Travel Time= 7.4 min

Peak Storage= 445 cf @ 0.74 hrs, Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 52.39 cfs

0.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 894.0' Slope= 0.1672 '/'
Inlet Invert= 5,740.00', Outlet Invert= 5,590.50'

Reach R1: Channel #2



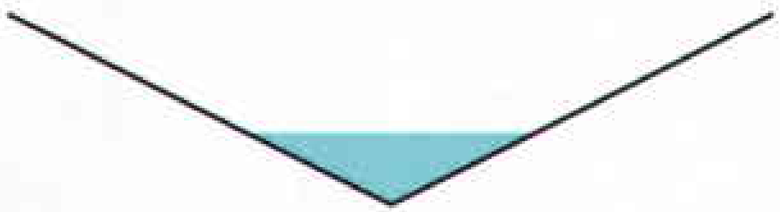
Summary for Reach R2: Channel #2

Inflow Area = 96.200 ac, 0.00% Impervious, Inflow Depth = 0.01"
Inflow = 2.78 cfs @ 0.78 hrs, Volume= 0.093 af
Outflow = 2.66 cfs @ 0.88 hrs, Volume= 0.093 af, Atten= 4%, Lag= 5.9 min

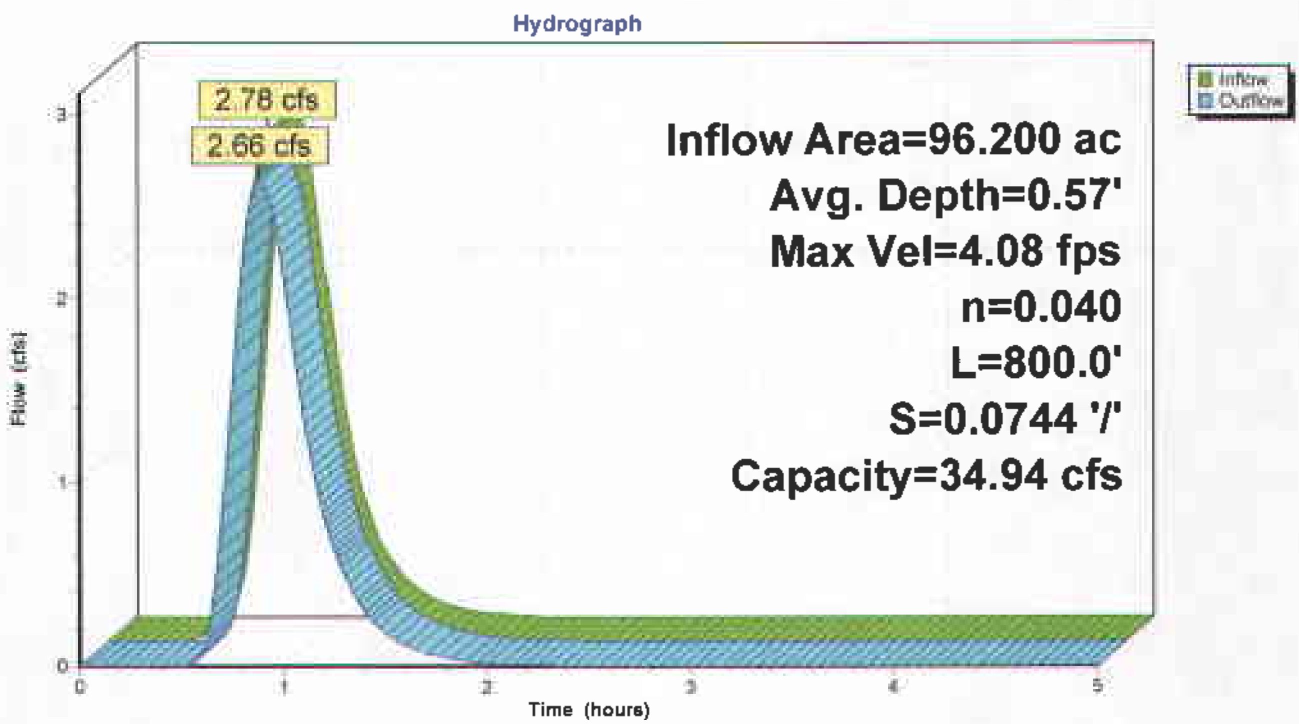
Routing by Stor-Ind+Trans method, Time Span= 0.00-5.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.08 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 1.23 fps, Avg. Travel Time= 10.9 min

Peak Storage= 522 cf @ 0.83 hrs, Average Depth at Peak Storage= 0.57'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 34.94 cfs

0.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 800.0' Slope= 0.0744 '/'
Inlet Invert= 5,589.50', Outlet Invert= 5,530.00'



Reach R2: Channel #2



APPENDIX 111-2

RECLAMATION SLOPE STABILITY CALCULATIONS

Slope Stability of Gypsum Fill

Approach:
The slope stability for the gypsum fill was analyzed using Slide 5.0 by RocScience. This software uses the "method of slices" to evaluate factors of safety for various trial arcs that may occur throughout the slope. The failure surface is discretized into small slices and the driving and resisting forces/moments are calculated for each and summed over the entire failure surface to obtain a factor of safety.

Model Parameters:
The gypsum fill slope was analyzed within Slide using Bishop's Simplified Method. This method is the most common used in practice since it has been found to compare well with actual failure surfaces that occur in the field (Dunn et al, 1980).

The input parameters for this model are as follows:

Fill unit weight: 135 pcf – Typical unit weight of poorly sorted, very mixed-grained fills (Dunn et al, 1980).

Fill cohesion: 0 – Assumed to be cohesionless due to the absence of clay minerals and moisture. Conservative measure since cohesion helps resist sliding.

Internal angle of friction (Φ) of fill: 40° - Expected to range from 40°-45° due to presence of large boulders and angularity of fill (Holtz et al, 1981). Sensitivity to internal angle of friction is evaluated as well.

Minimum depth of sliding surface: 1 foot – The minimum depth for a sliding surface was limited to one foot. This allows the software to only evaluate failure surfaces with significant mass movement of fill material. Also, due to the presence of large boulders with diameters in excess of one foot, a failure surface is not expected to develop above this depth.

Results:
Nearly 5,000 various failure surfaces were evaluated within the boundaries of the gypsum fill. The critical failure surface and corresponding factor of safety are displayed as follows for a friction angle of 40° and 45°. The grid shown above the soil profile represents the origins of various failure surfaces with varying radii.

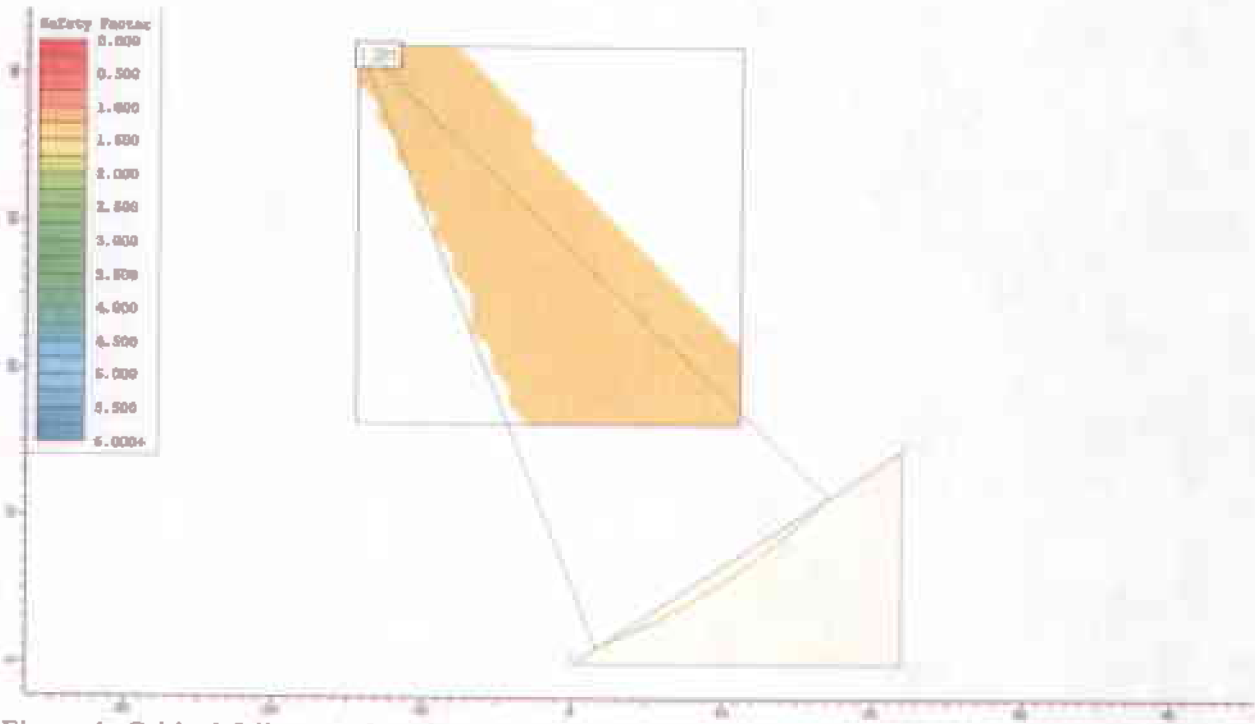


Figure 1: Critical failure surface for $\Phi = 40°$, FS = 1.29

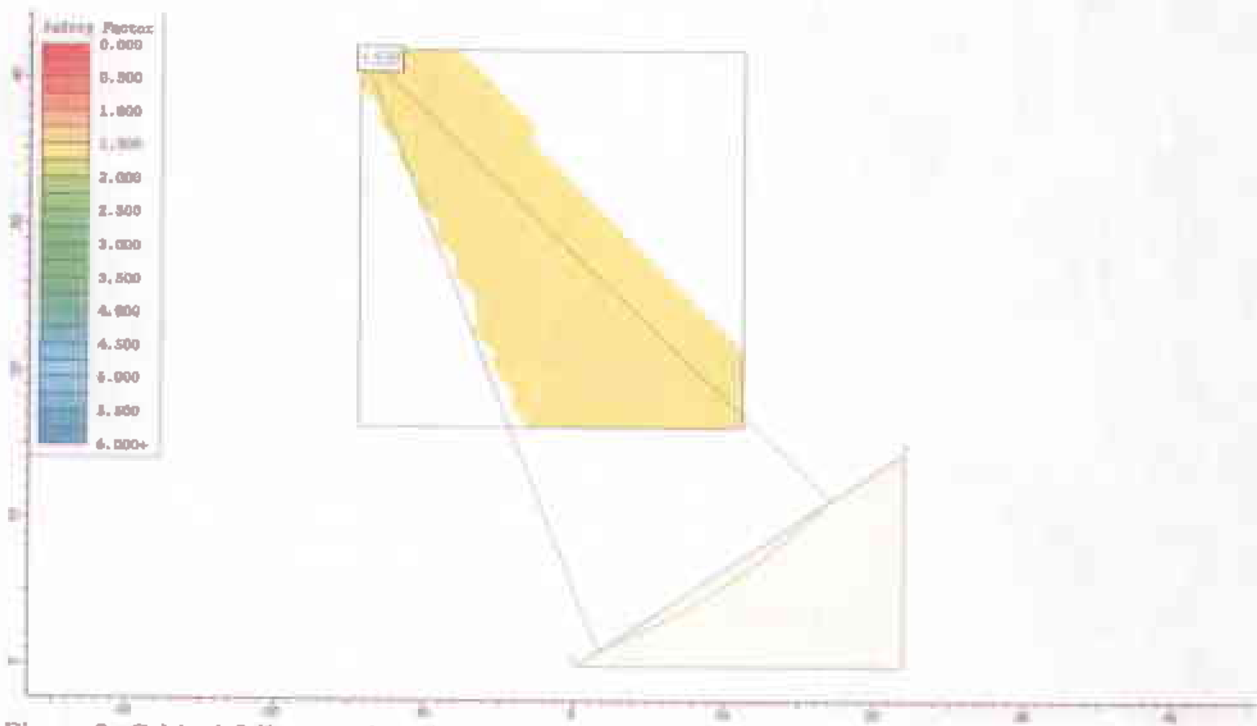


Figure 2: Critical failure surface for $\Phi = 45°$, FS = 1.54

References:

Dunn, I.S., Anderson, L.R. and Kiefer, F.W. (1980). Fundamentals of Geotechnical Analysis. New York: John Wiley & Sons.

Holtz, R.D. and Kovacs, W.D. (1981). An Introduction to Geotechnical Engineering. Englewood Cliffs, NJ: Prentice Hall.

APPENDIX 113-1

SURETY CALCULATION

TABLE 113-1
RECLAMATION BOND COST ESTIMATE
SUNROC CORPORATION
CHICKEN CREEK MINE

Item No.	CSI No	Description	Quantity	Unit	Material Cost Per Unit	Material Cost Total	Equipment Cost Per Unit	Equipment Cost Total	Labor Cost Per Unit	Labor Cost Total	Project Cost Per Unit	Project Cost Total
		CLEANUP, REMOVAL, DEMOLITION/BURIAL OF FACILITIES/STRUCTURES										
		NONE										
		REMOVAL/DISPOSAL OF HAZARDOUS MATERIALS										
		NONE										
		BACKFILLING, GRADING, AND CONTOURING										
1	3123 2318 4500	Water Truck for Reclamation Project (Dust Control, light)	20	Day			400.00	8,000.00	245.00	4,900.00	645.00	12,900.00
2	0221 1313 0400	Surveying - Boundary and Survey Markers, Lot location and lines, average	45.0	AC	64.00	2,880.00	69.00	3,105.00	1,300.00	58,500.00	1,433.00	64,485.00
3	3123 1630 0020	Drilling and blasting rock, open face, over 1,500 CY		BCY	2.50		5.80		3.56		11.86	
		Drilling and Blasting Benches	24,437	BCY	2.50	61,092.50	5.80	141,734.60	3.56	86,995.72	11.86	289,822.82
		Assume 17.6'x17.6' triangular x-section cuts along benches. East Pit Length 2,110 ft. LW Pit 2,150 ft.										
4	3123 1646 5220	Cat D8R Dozer contouring without Ripper (300 HP, 150' haul, common earth)		BCY			1.74		0.55		2.29	
		Blade drilled/blasted material (24,437 cy) and berms surrounding pit (6,000cy)	30,437	BCY			1.74	52,960.38	0.55	16,740.35	2.29	69,700.73
5	3123 1642 0300	Rough grading, with a backhoe, hyd., crawler mounted, 3 CY cap., 160 CY/hr		BCY			1.12		0.27		1.39	
		Access roads	14,000	BCY			1.12	15,680.00	0.27	3,780.00	1.39	19,460.00
		Assume 2 cy grading per foot of access road, 7,000' of access roads to be reclaimed										
											SUBTOTAL	**456,368.55**
		SOIL MATERIAL REDISTRIBUTION AND STABILIZATION										
6	3123 1646 5220	Cat D8R Dozer contouring without Ripper (300 HP, 150' haul, common earth)		BCY			1.74		0.55		2.29	
		Spread Topsoil	2,777	BCY			1.74	4,831.98	0.55	1,527.35	2.29	6,359.33
7	3123 2318 2090	Hauling 42 CY, rear or bottom dump, 1000 ft. rt, 3.6 loads/hr		LCY			1.13		0.19		1.32	
		Haul topsoil	2,777	LCY			1.13	3,138.01	0.19	527.63	1.32	3,665.64
8	3123 1642 1350	Rough grading/Loading with Front End Loader, 5 CY cap		BCY			0.97		0.34		1.31	
		Load topsoil	2,777	BCY			0.97	2,693.69	0.34	944.18	1.31	3,637.87
											SUBTOTAL	**13,682.84**

TABLE 113-1
RECLAMATION BOND COST ESTIMATE
SUNROC CORPORATION
CHICKEN CREEK MINE

Item No	CSI No	Description	Quantity	Unit	Material Cost		Equipment Cost		Labor Cost		Project Cost	
					Per Unit	Total	Per Unit	Total	Per Unit	Total	Per Unit	Total
		RIPPING PIT FLOORS, ACCESS ROADS, SLOPES										
9	3123 1646 5220	Cat D8R Dozer ripping and push to FEL (300 HP, 150' haul, common earth)		BCY			1.74		0.55			
		Blade and rip non-benched slopes	2,777	BCY			1.74	4,831.98	0.55	1,527.35	2.29	6,359.33
		Assume non-benched area = ac, ripped to 2' deep										
10	3123 1632 01600	Ripping Bench Access Roads (Medium hard, 300HP Dozer, ideal conditions)		BCY			2.44		0.73		3.17	
		Assume 2 cy ripping per foot of access road, 7,000' access roads	14,000	BCY			2.44	34,160.00	0.73	10,220.00	3.17	44,380.00
											SUBTOTAL:	50,739.33
		DRAINAGE RECONSTRUCTION										
11	3123 1646 5220	Cat D8R Dozer contouring without Ripper (300 HP, 150' haul, common earth)		BCY			1.74		0.55		2.29	
		Recontour sedimentation pond	8,624	BCY			1.74	15,005.76	0.55	4,743.20	2.29	19,748.96
12	3123 1642 0300	Rough grading, with a backhoe, hyd., crawler mounted, 3 CY cap., 260 CY/hr		BCY			1.12		0.27		1.39	
		Reclamation Channel	5,711	BCY			1.12	6,396.32	0.27	1,541.97	1.39	7,938.29
		Assume 1 cyd grading per foot of reclamation channel										
											SUBTOTAL:	**27,687.25**
		MULCHING/REVEGETATION										
13	3292 1914 5600	Seeding, wildflower, 0.1#/MSF, hydro or air seeding w/much, fert		MSF	4.36				30.50			
		pit and road	602	MSF	4.36	2,624.72			30.50	18,361.00	34.86	20,985.72
		Assume disturbed area of Both Pits = 602,000 sq ft										
14	3291 1316 0350	Mulching, hay, 1" deep, hand spread during gouging		SY	0.46				0.51	0.00	0.97	
		pit and road	66,889	SY	0.40	26,755.60			0.51	34,113.39	0.91	60,868.99
15		Deep gouging/mixing in mulch with excavator										
	3123 1632 2200	Ripping shale, soft, 300 HP dozer, ideal conditions	2,777	BYC			0.98	2,721.46	0.29	805.33	1.27	3,526.79
											SUBTOTAL:	**85,381.50**
Note: All unit costs from 2008 Means Heavy Construction Manual												

TABLE 113-1
RECLAMATION BOND COST ESTIMATE
SUNROC CORPORATION
CHICKEN CREEK MINE

Item No.	CSI No	Description	Quantity	Unit	Material Cost Per Unit	Material Cost Total	Equipment Cost Per Unit	Equipment Cost Total	Labor Cost Per Unit	Labor Cost Total	Project Cost Per Unit	Project Cost Total
		DIRECT COSTS										
		RSMEANS ITEMS										
		CLEANUP, REMOVAL, DEMOLITION/BURIAL OF FACILITIES/STRUCTURES	$ -									
		REMOVAL/DISPOSAL OF HAZARDOUS MATERIALS	$ -									
		BACKFILLING, GRADING, AND CONTOURING	$ 456,368 55									
		SOIL MATERIAL REDISTRIBUTION AND STABILIZATION	$ 13,662 84									
		RIPPING PIT FLOORS, ACCESS ROADS, SLOPES	$ 50,739 33									
		DRAINAGE RECONSTRUCTION	$ 27,687 25									
		MULCHING/REVEGETATION	$ 85,381 50									
		SUBTOTAL RSMEANS ITEMS	$ 633,839 47									
		LOCATION FACTOR (77 6%)	$ (141,980 04)									
		ITEMS NOT ESTIMATED USING RS MEANS										
		GENERAL SITE CLEANUP	$ 2,000 00									
		TOTAL DIRECT COSTS	$ 493,859 43									
		INDIRECT COSTS										
		MOB/DEMOB (5%)	$24 692 97									
		CONTINGENCIES (10%)	$49 385 94									
		CONTRACTOR OVERHEAD AND PROFIT (10%)	$49 385 94									
		RECLAMATION MANAGEMENT FEE (10%)	$49 385 94									
		TOTAL INDIRECT COSTS	$172,850 80									
		SUBTOTAL RECLAMATION COST	$666 710 23									
		ESCALATION 3 20% OVER 5 YEARS	$113 722 73									
		TOTAL RECLAMATION COST	$780 432 96									

Note: Location factor taken from RSMeans Site Work and Landscape Cost Data 2008 for Price, UT
Bond estimate only for Lower West Pit and East Pit. Upper West Pit will not be constructed until at least 2030